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The Mining Magazine

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CONTENTS

EDITORIAL

USUALLY held in the autumn this year's Engineering, Marine, Welding, and Nuclear Energy Exhibition has been re-arranged for the spring. It takes place at Olympia, London, from April 16 to 30 and it is expected that there will be over 500 exhibitors. Advance information seems to show that many new and improved engineering products and materials will be on show, including a wide range of nuclear energy equipment.

NOTICE has been received from Canberra that the Bureau of Mineral Resources has now started the collection and compilation of monthly data for the lead, zinc, and copper industries on a standardized basis. As soon as possible after receipt and compilation data for each calendar month on mine production, smelter production, local sales, and exports are to be issued by the Bureau. Such figures are provisional and they will be revised in the final official quarterly and yearly figures. It is hoped that this new service will ensure that in future there will be no variation in Australian data as reported by different organizations.

COVERING the use that is made of the fire-damp occurring in mines a recent booklet [1] issued by the Organization for European Economic Co-operation deals with "Drainage and Use of Methane from Coal-Fields: Developments since 1956." Recent work in Great Britain is reviewed. This shows that in the period from 1950 to 1957 the number of collieries practising methane drainage has risen from six to 46 and the quantity of pure methane utilized has gone up from 2,800,000 cubic metres to 35,400,000 cubic metres. It is planned in the next five years, it is stated, to double both the number of mines draining off fire-damp and the quantity of the gas taken off. Most of the methane drained in this country is obtained from cross-measure bore-holes, although in one colliery it is drained from worked-out areas and in another from a seam ahead of the long-wall face.

[1] Paris: O.E.E.C. Price 6s.

IMPORTANT events affecting tin producers and consumers are reviewed in the second annual report of the International Tin Council.[1] This covers the year ended June 30 last, in the whole of which period the Buffer Stock manager of the Council was buying tin, particularly after the market price touched the floor price in the Agreement in October, 1957. By the middle of 1958 the Buffer Stock had reached 23,300 tons of tin. The control of exports from the producing countries in the Agreement was first put into operation on December 15, 1957, and has remained in operation since, although unchecked supplies of tin from the U.S.S.R. began to affect the market. The report summarizes all the activities of the Council and also contains the Buffer Stock accounts, showing the contributions of each producing member, an income for the year of £17,140,000, and an expenditure of £72,000.

FROM April 27 to 30 next a Corrosion Exhibition is being staged in the Horticultural Hall, Westminster. There the Corrosion of Metals Group of the National Chemical Laboratory is to demonstrate its own work, designed to gain more insight into corrosion processes and the use of preventive measures in order to assist industry. In connexion with corrosion of metal pipes or dividing walls in heat-exchange systems experimental water circulating systems have been designed to investigate the effects of water composition, speed of flow, and temperature. An extremely sensitive means is being used, it is stated, to find out how compounds such as chromates prevent corrosion. This involves the use of radioactive tracer in the form of sodium chromate containing radioactive chronium. In addition,

[1] London: International Tin Council. Price 7s. 6d.

the effects of various kinds of deposit initiated by the use of the so-called volatile corrosion inhibitors are being investigated. This method of testing is also to be demonstrated at the Exhibition.

A Notable Golden Jubilee

A correspondent in Western Australia reminds us that 1899 was a glamour year in that State and to that the Lake View Consols contributed a major share. On May 18, 1896, the Consols had for £220,000 in fully-paid £1 shares taken over the Great Boulder East and Lake View leases previously worked by an Adelaide company known as the Great Boulder East and Lake View Company, leases which had been pegged by W. G. Brookman and S. A. Pearce—a fortunate pair—in 1893. The company installed the first treatment battery on the Boulder field (Golden Mile). It was opened with ceremony on October 4, 1894. " This function," said Brookman, " will be the forerunner of many such to follow : and will ensure rich dividends for years to come."

On the Lake View lease the outcrop of what became the Lake View Lode was worked and a Main Shaft was put down near to the north-west corner, with others as well both to north and south. The No. 2 S. Shaft was also known as " W.G." Not a great distance north of Main Shaft the lode line crossed the lease line in Great Boulder East and continued, going north right up to the boundary of the Perseverance lease. The lode carried on right through the length of Perseverance and South Kalgurli. Good crushings and rich yields followed the opening of the plant and in the period from November, 1894, to June, 1896, 6,142 tons of ore yielded 17,060 oz. of gold. The Consols took over and developed the lode to the 200-ft. level along a nearly continuous line of 2,500 ft. mainly in oxidized ore with a width of 8 ft. to 10 ft. but very wide at some points, extending through to the surface. The oxidized ore from the lode went to the mills while in the meantime plant for treating sulphide ore was being installed. Tellurides were first reported by Holroyd, in June, 1896, and noted on all Boulder Belt mines during the succeeding years.

In 1898–99 Mr. H. C. Callahan was manager and developments had reached the 300-ft. level with the shaft being steadily deepened. In 1899 while driving south at the 300-ft. level rich stone was entered which " for 300 ft. averaged 3–4 oz. per ton." Winzes were sunk at intervals from the level above, blocking out the ore for stoping and at the same time disclosing an equal grade between levels. At just beyond 300 ft. south, without warning, the gold values rose from the several ounces to 30 oz. and even 60 oz. per ton, with large masses of telluride as well as stone less spectacular but shot through with fine telluride. A report stated : " This is perhaps the most phenomenal shoot of gold known ; the stone is broken out as it comes, right across the vein, and mixed, sampled and bagged. . . . Occasionally veins and patches of telluride gold are met with and splashes occur all over the faces and back of the drive, but the main mass of the ore is not showy. The distinguishing feature appears to be in the comparative absence of pyrite and the even distribution of the fine telluride." Each foot of driving in the rich bonanza shoot yielded about 4 tons of ore valued at more than 25 oz. per ton—*i.e.*, about 100 oz. per ft. Actually the first 100 tons sampled showed 67 oz. of gold and 7 oz. of silver per ton, worth £26,000.

In April, 1899, Callahan made arrangements to ship 1,000 tons of rich ore to New South Wales for smelting, expecting the value to be 25 oz. to 30 oz. per ton and in May he received permission from the directors to increase the mine output to about 30,000 oz. per month. The first return (that for May) amounted to 33,080 oz. from 8,450 tons of ore milled, of which 23,570 oz. came from 450 tons of telluride shipped to the smelter. It was reported at the time that " the field has previously seen some ore of sensational value shipped, but it is without parallel for stone to average like that of the Consols, in quantity and without picking."

The main south drive at 300 ft. was carried a distance of about 700 ft. and to the north of the shaft a similar distance towards the Perseverance boundary. " While not exceptionally rich it is thought that the lode would average 1–2 oz. per ton for a width of 10 ft. up to 20 ft. ; towards the north end of the lease the ore becomes exceedingly wide, up to 60 ft. and so passes into the Perseverance. . . . The main drive from south to north would be about 2,400 ft. in length." In the next six months the 38,838 tons of ore milled yielded 164,396 oz. of gold. However, in December, 1899, Mr. T. C. Hewitson of the Ivanhoe took charge of Lake View Consols and at that apparently the " ton of gold a month " phase of that remarkable mine came to an end—60 years ago.

O.E.E.C. on the Outlook

In the middle of February the Organization for European Economic Co-operation issued its 10th annual economic review. This shows that in the past six years Western Europe has passed through its first relatively normal business cycle—a phase of healthy expansion followed by an inflationary boom and then by a mild recession. Governments made major changes in economic policy, seeking to reconcile economic expansion and full employment with greater price stability and a healthy balance of external payments, but these policies, it is suggested, have met with only limited success. In most countries, it is pointed out, governments have taken action in an expansionary direction and although unemployment has not yet been affected production is now generally moving slowly upwards. With a few exceptions countries have now achieved the conditions for healthy expansion ; the balance of payments is good, reserves are high, and pressure on prices is much less than in the past few years. The main problem is, therefore, the report says, to secure an adequate rate of economic growth. In this respect the view is expressed that " the experience of the last few years suggests that Europe should be able to achieve high rates of growth on a sustained basis without undue pressure on the balance with the United States as long as inflationary demand on the domestic supply of materials is avoided."

It is of interest to note that the views expressed here are supported from another quarter. In the " Review of Non-Ferrous Metals in 1958 " just published by the British Metal Corporation it is reported that at the start of 1959 the outlook is much better than a year ago. Then early prospects for the American economy seemed anything but hopeful. Now U.S. business activity has picked up strongly from the lowest points of 1958 and further recovery is generally expected in 1959. Elsewhere, despite a somewhat uneven impression from country to country, it seems likely that the overall demand for the metals will rise still higher in 1959. The background to this is, it is suggested, the world's ever increasing population, spreading industrialization, and rising standards of living, not to mention the quickening technology of the age, " of which perhaps the launching of Russia's sun satellite, as 1959 opened, is the most vivid reminder yet." Present prices of the metals are low rather than high and, on the reckoning that consumption does make headway in 1959, it is considered that base-metal producers can reasonably look forward to firm markets and to a more profitable year than they had in 1958.

Tin Research

The International Tin Research Council, founded in 1932 with the object of developing the consumption of the metal, has now issued the report of the Research Institute for 1958.[1] The Institute, financed by the major world producers through the International Council, is engaged on research to develop new uses for tin, as well as endeavouring to improve existing products and manufacturing processes. Current work covers hot-tinning, tinplate corrosion, electroplating, the development of tin-base alloys and of the use of tin as an alloying agent, soldering, casting, and the design of organotin compounds. The Institute has also continued to assist the British Standards Institution in the preparation of standard methods of analysis for tin ingots and tin-lead solders and work has now begun on the preparation of analytical methods for bearing metals. In view of the diversity of forms in which bearing metals are sold and also because of the possibility of segregation in these alloys a good sampling procedure, the report says, is an essential preliminary and the co-operation of industry is being sought on this question. The Institute has also co-operated with other laboratories in the preparation of a British chemical standard for a lead-base white metal and is now engaged on the chemical analysis of a Standard pure tin.

In the course of this account of its activities the Institute report mentions many newly-discovered facts about tin, its alloys, and chemical compounds. The electrical industries, for instance, will be interested in work on solderability of various coatings on metals, while packers will take note that methods for improving the quality of tinplate continue to be investigated and the significance of porosity in tin coatings is being studied further. Other items of interest include the work on new alloys of tin with the " newer " metals—such as, titanium, vanadium, and zirconium—as well as in the fact that tin-nickel plating is now being taken up by the watch and instrument industries.

[1] Greenford Middlesex : Tin Research Institute, Publication No. 294.

MONTHLY REVIEW

Introduction.—The easing of the situation in Cyprus and the ensuing growth of confidence have been tempered by the outbreak of unrest in Nyasaland, evidence that the Central African Federation is not entirely welcome to the native population. Nevertheless there is a general feeling that the 1958 setback in business has been overcome and that the Budget for the next financial year may provide another impetus towards improved trading.

Transvaal.—The feature of the returns of the Transvaal and Orange Free State Chamber of Mines for February is the remarkable growth in the labour force. The total of 350,656 natives at work in the gold mines at the end of January advanced to 369,217 at the end of February. In the last-named month the output of the mines is given as 1,472,090 oz., making with 34,618 oz. from outside mines a total of 1,506,708 oz. for the month.

The report of the MESSINA (TRANSVAAL) DEVELOPMENT COMPANY for the year ended September 30 last shows a profit of £687,141 and a total of £735,431 available, of which dividends totalling 6s. 6d. a share required £429,000. In the year 15,452 tons of copper was produced from Messina and Umkondo ores and it can be noted that mine working costs per ton of recoverable copper fell from £131 in the previous financial year to £120 a ton. The Messina ore reserves at September 30, 1958, were 5,509,650 long tons assaying 1·74% copper—while at Umkondo the proved and probable ore reserves were 206,070 long tons averaging 4·21% copper after including 3·32% from oxides. In addition possible ore reserves were 204,690 long tons averaging 2·56% copper after including 0·98% from oxides. On March 10 the company announced that it had been decided to proceed immediately with the erection of a smelting and refining plant in Southern Rhodesia for the purpose of producing fire-refined copper. A new company, to be known as the MESSINA RHODESIA SMELTING AND REFINING COMPANY is to be formed with an initial capital of £750,000, of which £600,000 will be subscribed by Messina and £150,000 by M.T.D. (MANGULA). The primary purpose of this plant, it is stated, will be to treat the output from M.T.D. (Mangula) and other copper properties in Southern Rhodesia as they are brought into production by Messina (Transvaal) Development. It is also the intention that it will operate as a custom smelter. The plant is to be sited on rail near Alaska, 13 miles west of Sinoia, and estimated that it will be in operation within 18 months.

In the December quarter the ROOIBERG MINERALS DEVELOPMENT COMPANY produced 323 long tons of tin concentrates, operations resulting in an estimated working profit of £39,958.

Shareholders of KLERKSDORP CONSOLIDATED GOLDFIELDS have been informed that the Atomic Energy Board has indicated that "the present accepted uranium producers produce more than sufficient uranium for the Board to meet its present contracts. There is, therefore, no need to admit any further producers to the production scheme . . . no indication can be given as to whether it will be possible to admit the Klerksdorp Consolidated Goldfields as a uranium producer in the foreseeable future."

The accounts of the CONSOLIDATED MINES SELECTION COMPANY for 1958 show a profit of £266,008 and £425,705 available. Dividends totalling 2s. 6d. per stock unit require £142,636. At the annual meeting later this month resolutions are to be submitted providing for the capitalization of £99,225 forming part of capital reserve (share premiums) and for the issue to members (in the proportion of one new share for every 10 stock units of 10s. each held) of 198,450 fully-paid ordinary shares of 10s. each.

A group profit of £1,454,136 is reported by the RAND SELECTION CORPORATION for the year ended September 30 last. Of the £1,758,683 dealt with in the accounts £937,500 is required for dividends totalling 2s. 6d. a share.

The SOUTH AFRICAN TOWNSHIPS, MINING, AND FINANCE CORPORATION reports a profit of £374,535 for the year to September 30 last, a dividend equal to 1s. a share requiring £240,000.

In the report for the year to June 30 last shareholders of ALPINE (BARBERTON) GOLD MINE are informed that as yet efforts to acquire a new mining enterprise in South Africa have been unsuccessful.

Orange Free State.—It has been announced that FREE STATE GEDULD MINES is to sink

a 22-ft. diameter circular shaft at a site approximately 4,000 ft. south of No. 1 shaft, to assist in the ventilation and more rapid exploration of that area. Initially, it is stated, the new shaft will be divided into two sections to provide both ventilation and hoisting facilities, while the final depth of the shaft will be determined in the light of geological information disclosed by a prospect bore-hole at present being drilled for the purpose.

South-West Africa.—Earlier this month it was announced that the SOUTH AFRICAN IRON AND STEEL INDUSTRIAL CORPORATION had bought for £75,000 the Uis tin mine, in the Brandberg area. The Corporation, it is stated, intends further exploration, to cost £50,000.

Southern Rhodesia.—The report of M.T.D. (MANGULA) for the year ended September 30, 1958—the first year of the company's operations—shows a profit of £3,740. It is stated that despite low production during the initial test period the first Aerofall mill produced 10,700 short tons of concentrates averaging 51·96% copper. This was shipped overseas. The ore reserves at September 30 last were estimated as 26,578,000 short tons assaying 1·34% copper.

The accounts of FALCON MINES for the year to September 30 last show a profit of £136,653. Of the £152,594 available £79,433 is required for dividends equal to 17½%. In the year the Dalny mine milled 224,000 tons of ore and recovered 41,527 oz. of gold while the Sunace treated 15,055 tons for 3,783 oz. and the Bay Horse 13,685 tons for 2,936 oz. The report states that at the Sunace mine modest profits were earned from the treatment of reclamation ore, but since the close of the year ore supplies have been exhausted and underground mining operations have ceased. Development results at the Bay Horse mine showed no improvement and by the end of the year the exploration programme was nearing completion. Mining operations are likely to cease during the current year and thereafter activities will be confined to the re-treatment of the old tailings, which will commence as soon as plant from the Sunace becomes available.

It is reported that emerald mining on the Belingwa claims, where a rich strike of precious material was recently announced, is to start during the current month.

Ghana.—The ASHANTI GOLDFIELDS CORPORATION reports a profit of £1,314,378 for the year to September 30 last, the accounts showing £1,924,014 for appropriation. Of this amount £545,164 has been set aside for taxation and £170,000 placed to reserve, while £673,050 is required for the dividends and bonus equal to 2s. 6d. share, leaving £535,800 to be carried forward. In the year under review the mill treated 365,198 tons of ore at an average grade of 17·39 dwt. for a yield of 282,530 fine oz. of gold. The ore reserves at September 30, 1958, were 1,586,300 tons at an average grade of 19·0 dwt.; the tonnage is 136,316 tons greater than at the end of the previous year, for a fall of 0·1 dwt. As was noted in the February issue it is proposed to capitalize monies standing in reserve.

The report of BIBIANI (1927) for the year ended September 30 last, shows a profit of £78,523 and a total of £327,122 for appropriation, of which dividends totalling 4·8d. per share require £28,750. In the year the tonnage treated by the mill was 403,787 and the gold recovered 82,650 fine oz. The tonnage is the highest ever reached by the mine and the recovery of gold is the highest since 1941. The ore reserves at September 30, 1958, were 1,027,391 tons at an average grade of 5·22 dwt.

Speaking at the annual meeting of GHANA MAIN REEF last month the chairman referred to the fact that the company was no longer in receipt of a Government grant and said that the amount contributed by Government, some £26,496, for the years 1957 and 1958, had been used to great advantage. The end, he said, was not primarily to advance development footage at a very much higher rate but rather to co-ordinate increased development with further shaft sinking so as to preserve a balanced tonnage from the various sections of the mine.

The operations of KONONGO GOLD MINES for the year ended September 30 last resulted in a profit of £200,582. The accounts show £286,257 available, of which £76,500 has been set aside for taxation and £100,685 distributed as dividends, equal to 6d. a share. During the year 67,770 tons of ore was treated and 45,869 oz. of gold recovered. The proved ore reserve at September 30, 1958, was estimated at 182,865 tons averaging 15·5 dwt. per ton over an average width of 60 in.; included in this tonnage is the reserve of ore in pillars of 27,675 tons averaging 17·0 dwt. As compared with the end of the previous financial year the tonnage is less by 6,545 tons and the grade higher by 1·0 dwt. per ton.

In the three months to December 31 last,

BREMANG GOLD DREDGING treated 2,332,330 cu. yd. of ground and recovered 14,073 oz. of gold. The report for the period states that in the quarter the section of the river directly in front of the dismantling site was dredged and No. 3 dredge finally closed down for dismantling on December 2 and immediately work commenced on its transfer from the Ankobra River for re-erection on the prepared site on the Middle Offin. A high rate of progress is being maintained in all sections of this work and it is actually ahead of schedule, the report states.

The accounts of the FANTI CONSOLIDATED INVESTMENT COMPANY for 1958 show a profit of £123,439. After adding £24,444 brought forward from the previous year, making provision for taxation of £58,036, and transferring £15,782 to general reserve, there is an available balance of £74,065. A dividend of 10% and bonus of 5% absorb £48,041, which leaves £26,024 to be carried forward.

Correction.—It is regretted that in the last issue of the MAGAZINE the output of ARISTON GOLD MINES for January was given as 2,463 oz. This should, of course, have been 12,463 oz.

Nigeria.—Shareholders of TIN FIELDS OF NIGERIA have been informed that the directors have received an offer for the whole of the issued shares of the company of approximately 6d. per share. Negotiations are proceeding and it is hoped to advise of the outcome in the near future.

Tanganyika Territory.—In the three months ended December 31 last ALAMASI, LTD., treated 60,008 loads of ground and recovered 4,059 carats of diamond. This included specified stones of 23½, 17, and 11¾ carats.

Belgian Congo.—Shareholders of the UNION MINIÈRE DU HAUT KATANGA were recently informed that production for 1958 as well as capital works for the development and modernization of the company's operations proceeded according to programme. Sales of copper for the year kept pace with the tonnage produced and the results justify forecasting a dividend for 1958 equal to that distributed for 1957.

Australia.—Last month the directors of the BROKEN HILL PROPRIETARY COMPANY announced their intention to issue approximately 10,616,000 shares at par to existing holders in the proportion of one new share for each five held. The shares are to be payable 10s. on June 15 and 10s. on December 15.

Late in 1958 a scaffolding was erected about the 200 ft. smoke stack from two roaster furnaces at the treatment plant of GOLD MINES OF KALGOORLIE (AUST.) for the purpose of examination of the stack and testing of thickness. The scaffolding is the highest ever erected in Western Australia. More than a mile of 1½-in. piping was used and to 190 ft. in height the erection took just over a week.

Shipments of Peak Hill manganese ore—stockpiled at Meekatharra, Western Australia, are being resumed, after a hold up of several months. About 14,000 tons are to be shipped at a rate of 1,000 tons a week.

New Zealand.—The British Petroleum Company recently announced that Shell-BP and TODD OIL SERVICES, LTD., have begun drilling the first test well near Hawera, in the west coast area of the North Island. Preparatory survey work for this well has taken three years and cost about £1,000,000. In the east coast area of the North Island, where BP Exploration is the operating company for BP-Shell and Todd Petroleum Development, Ltd., seismic surveys are being carried out and a site for the first test well in the area is being sought.

Malaya.—The report of PETALING TIN for the year to October 31 last shows a profit of £24,493 and a credit balance of £140,081 carried forward. In the year 6,552,900 cu. yd. of ground dredged yielded 823·6 tons of tin concentrates.

India.—February 16 saw the inauguration by the INDIAN ALUMINIUM COMPANY of a new aluminium smelter which more than doubles India's capacity for the production of the primary metal. Built at a capital cost of $10,000,000, the smelter forms a part of a $30,000,000 integrated expansion project involving bauxite, alumina, metal production, and fabrication. The establishment of smelting capacity at Hirakud is based on the supply of electric power from the State-owned 165,000-h.p. Hirakud generating plant and an expansion of the existing bauxite and alumina production facilities in Bihar State. The Indian company has under consideration plans to expand the Hirakud smelter to 22,400 tons capacity and discussions are currently taking place with the Orissa Government for the supply of the additional power required. A 61% interest in the company is held by ALUMINIUM, LTD.

Burma.—In the six months to December 31 last the BURMA CORPORATION (1951), jointly owned by BURMA MINES, LTD., and the Union

Government, treated 62,176 tons of ore and produced 9,730 tons of lead, 274 tons of antimonial lead, and 840,517 oz. of silver, as well as 185 tons of copper matte, 318 tons of nickel speiss, and 9,840 tons of zinc concentrates. The operating profit for the six months is given as £123,795.

United States.—Shareholders of the MOUNTAIN COPPER COMPANY have been informed that 1958 was "an unusually difficult one" as regards trading conditions in the United States. Pyrites sales fell well below normal, but, on the other hand, the Martinez chemical plant experienced a good year. "In all the circumstances," it is stated, "so far as can be judged at present the combined profits of the parent company and its subsidiary, Mountain Copper Company of California, will be rather better than for the previous year."

Canada.—Early this month ALUMINIUM, LTD., reported a preliminary net income figure for 1958 of £22,400,000, or 74 cents per share, compared with $41,400,000, or $1·37 per share, in 1957. Consolidated sales of aluminium in all forms for the fourth quarter of 1958 totalled 142,000 tons, as compared with 154,000 tons in the same period of 1957. Late last month the installation of an aluminium sheet mill in Spain was completed by an associate. The company, ALUMINIO IBERICO, S.A., at Alicante, in Southern Spain, had a cold strip mill installed this month following completion of a hot mill in November. This brings the plant's annual capacity to 18,700 tons of semi-fabricated aluminium products, including 13,000 tons of sheet products. About three-fourths of Aluminio Iberico's production is marketed in Spain to serve the country's growing industrial expansion.

Anglo-French Exploration Co.—The accounts of the Anglo-French Exploration Company for 1958 show a profit of £56,164 and a total of £81,175 available. After providing £53,906 for a dividend equal to 1s. 10½d. per unit of stock and making other allowances there was £9,269 to be carried forward.

Consolidated Zinc Corporation.—Shareholders of the Consolidated Zinc Corporation have been informed of an issue of 1,455,100 ordinary shares of £1 each offered at 48s. per share to existing holders in the proportion of one new share for every six held. Funds are needed to meet projects in hand and to finance future activities. Provisional figures for 1958 indicate a group net profit for the year, after providing for taxation, of approximately £1,560,000, as compared with £1,769,986 for 1957.

DIVIDENDS DECLARED

* Interim † Final

(Less Tax unless otherwise stated.)

†**Akim Concessions.**—Def. 8¾%; Ord., 13%, payable Apr. 4.

†**Anglo-French Exploration Co.**—1s. 10½d., payable Apr. 1.

†**Blinkpoort Gold Syndicate.**—40%, payable May 21.

***British Aluminium.**—13½%, payable May 1.

***Camp Bird.**—10%, payable Mar. 31.

***Central Mining and Investment Corporation.**—1s. 6d., payable Mar. 24.

†**Consolidated Mines Selection Co.**—1s. 6d., payable Mar. 24.

†**De Beers Consolidated Mines.**—6s., payable May 15.

***Falcon Mines.**—7½%, payable May 8.

***Free State Geduld Mines.**—3s. 6d., payable May 20.

***Gopeng Consolidated.**—3d., payable Mar. 13.

†**Kononga Gold Mines.**—4d., payable Mar. 25.

†**Kundang Tin Dredging.**—3s., payable Apr. 1.

†**Larut Tin Fields.**—25%, payable Mar. 18.

***London Tin Corporation.**—15%, payable Mar. 26.

†**Maroc.**—6%.

***Mount Lyell.**—2½%, payable Apr. 24.

***North Kalgurli (1912).**—18¾%, payable Mar. 31.

***Pengkalen.**—3d. and cash, 2d., payable March 26.

***President Brand Gold Mining.**—2s. 6d., payable May 20.

***President Steyn Gold Mining.**—1s. 3d., payable May 20.

†**Rhodesia Broken Hill.**—9·6d., payable May 15.

***Rhodesian Anglo American.**—2s., payable May 8.

†**Rhodesian Corporation.**—10%, payable Apr. 9.

***Rhokana Corporation.**—12s., payable May 8.

***Transvaal and Delagoa Bay Investment Co.**—5s., payable Mar. 20.

***Wankie Colliery.**—6d., payable May 22.

***Welkom Gold Mining.**—3d., payable May 20.

***Western Holdings.**—3s. 6d., payable May 20.

***Witbank Colliery.**—4s. 3d., payable Mar. 20.

***Yarra Falls.**—4%, payable Apr. 23.

METAL PRICES

Mar. 10.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	180	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	28	10	0
Silver		6	7⅜
Gold	12	9	4¾
Wolfram (U.K.)			
(World)	4	6	6

Tin, Copper, Lead, Zinc } See Table, p. 176.

Bulk Handling Titanium Sponge

A. E. Williams, Ph.D., F.C.S.

The Tote system installed in a United States plant is described.

The past decade has witnessed a great increase in the use of titanium in both iron and steel manufacture, wherein the addition produces alloys of superior properties. The effects of titanium additions to cast-iron are various, but they produce a fine grain size or a close-grained structure in both grey and white iron. In white iron, however, titanium is normally used very sparingly, because it tends to graphitize. This effect in grey iron is useful in improving machinability, by preventing the occurrence of hard spots such as may occur in strong iron through chilling at the corners of thin sections. The strength, hardness, heat-resistance, and corrosion-resistance of grey iron are improved by titanium, due to the finer graphite it produces. When used as a de-oxidizer in killed steel the effect of titanium is to de-oxidize the metal more completely than is possible with the usual manganese and silicon additions.

As an alloying element in steel the main use of titanium is for carbide control or to hold the carbon in a practically insolube form as titanium carbide, instead of permitting its solution and precipitation during heat treatment in the form of carbides of iron, manganese, or chromium. Such uses are typical of others in iron and steel.

With the development of titanium as an alloying addition and for use in the construction of components, particularly for aircraft,

Fig. 1.—Titanium Plant of the National Lead Co., New York State.

Fig. 2.—Tote Bin with 5,000 lb. of Titanium Sponge.

much thought had to be given to the handling of titanium sponge so as to maintain the high quality yielded by the metallurgical plants. Containers in which the sponge is held and transported have to be adequate to protect the sensitive metal from atmospheric or other source of contamination.

The U.S. output of titanium sponge in 1957 was approximately 17,500 short tons, as compared with 14,595 in 1956. The largest American titanium mine is that of the National Lead Company in New York State's Adirondack mountains (Fig. 1). Japanese output in 1957 was 3,078 short tons, against 2,512 in 1956. Production of titanium sponge in Britain is gradually increasing, being around 2,000 tons at the present time, and it is likely to increase appreciably when the £3,000,000 plant of I.C.I.'s Metal Division comes into full production. Thus the United States is the world's largest producer of titanium sponge with, possibly, Russia as the second largest.

With a constantly increasing production of this material the problem of handling, transporting, and storing it naturally arises and since the Americans are the largest manufacturers it is interesting to note how they tackle the problem. They sought a system which would handle the sponge economically, would be highly mobile, and which could be adapted to rapid expansion and changes in production techniques. Fortunately they already had in existence a bulk handling system that had been well tried out in other industries for dealing with many different types of products and after inspecting a typical installation the American sponge manufacturers decided such a method would meet their own needs. Hence, much of the American titanium sponge production is handled by the Tote system, which is designed and fabricated by Tote System, Inc., of Beatrice, Nebraska. Briefly the system comprises a number of rectangular bins constructed in high-strength, heavy-gauge, aluminium alloy. These are available in three sizes—of 42 cu. ft., 74 cu. ft., and 110 cu. ft. capacity. They are designed for easy handling by hand- or power-operated stillage or pallet truck, fork-lift truck, or overhead crane. Any of these appliances have access to the underside of the bin, for the latter is raised a few inches off the ground by four short stout legs. The bins have a standard filling aperture of 9 in. diameter for all three sizes and a standard size discharge door 34 in. by $14\frac{3}{4}$ in. Gaskets and fasteners have been designed to ensure dust and weathertight sealing. They are, therefore, hermetically-sealed containers which can be quickly filled and emptied as required. Being rectangular they occupy a minimum of space in warehouse or conveyance. Their shape also allows them to be tiered, so enabling storage rooms to be utilized from floor to ceiling. Since they are sealed containers there is no contamination of product when the latter is being transported, stored, or handled in the plant. Where covered storage space is not available the bins can be stored equally well in the open, for owing to the hermetic seal the bin contents are not affected.

One of the American organizations using the Tote system is Rem-Cru Titanium, Inc., of Midland, Pennsylvania. With the successful development of the Kroll reduction process of titanium tetrachloride with magnesium for the commercial production of titanium metal the Remington Arms Co., Inc., began research into the alloying, fabricating, and melting of titanium metal, and in 1950 joined with the Crucible Steel Company of America to form the new Rem-

Cru Titanium, Inc., which began operations in 1951. So rapid was the expansion at the Midland plant that by 1955 the company was despatching titanium by the carload. To handle the titanium sponge Rem-Cru acquired in 1955 about 60 Tote bins, each capable of handling 5,000 lb. of titanium sponge. In September, 1956, this number was increased to 125 and since then others have been acquired. The Rem-Cru company estimates that the use of the initial 60 bins saves as much as $25,000 a year in labour and container costs and in the elimination of delays. In addition the hermetically-sealed bins provide against contamination of the commercially-pure titanium sponge. Spillage is avoided and exact weight can be guaranteed.

At this plant, by the use of the Tote bins, the raw material can now be stored in the open, close to the feed point. On arrival at the plant the loaded bins are unloaded by crane, a number of eyelets being attached to the top corners of the bins for lifting purposes. In storage the bins are handled by fork truck, but on delivery at the blender the bins are again lifted by crane to the top of this unit where the seal is broken and the titanium sponge cascades through the opening created at the bottom of the front of the bin into the blending operation. The Rem-Cru company was one of the pioneers in the use of this system of handling titanium sponge.

Among the more recent organizations which have realized the importance of cost control in a highly competitive and youthful industry is the Mallory-Sharon Metals Corporation, of Niles, Ohio. This company acquired 60 Tote bins in the middle of 1957. At this plant titanium sponge is received from the company's sponge reduction plant in nearby Ashtabula, Ohio. It is carried from

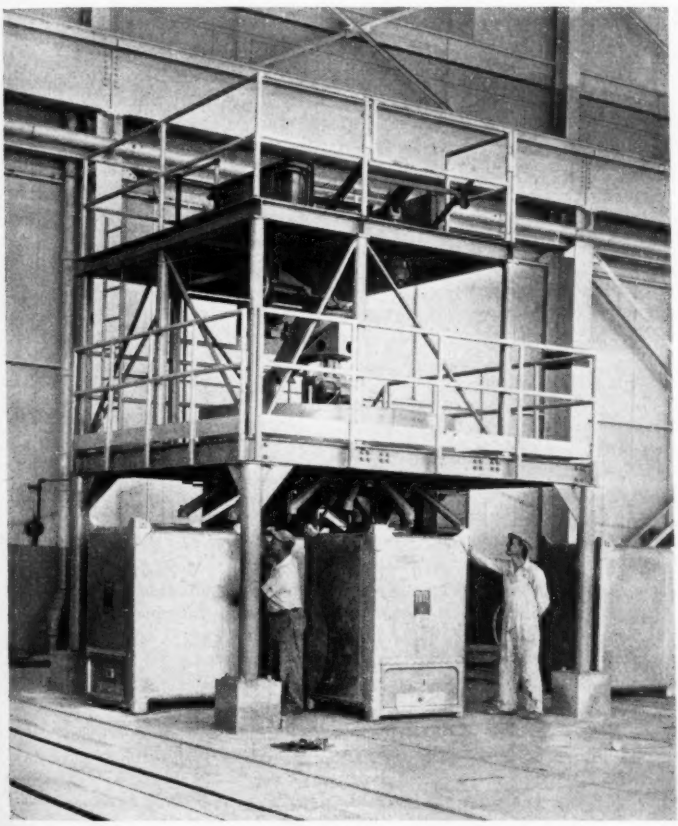

Fig. 3.— Empty Bins in Position for Filling Under Blending Power.

(Tote System, Inc.)

Fig. 4.— Handling Tote Bin with Fork-Lift Truck.

(*Tote System, Inc.*)

here to Niles in the 5,000-lb. capacity Tote bins by common carrier flatbed trucks. At the Niles plant it is removed from the truck either by fork-lift or overhead crane (Fig. 2). The bins are weighed, recorded, and removed to storage. Previous to the installation of the bins at this plant a number of 600 lb. capacity drums was used, but since the bins hold considerably more sponge per unit the time taken to unload is considerably less. Inventory records, too, are very much simplified, while from a protection point of view the sealed bins are a big improvement on the drums previously employed.

When the sponge is to be used the overhead crane moves the bin to a blending tower designed and constructed by Mallory-Sharon engineers. Here the sponge is cascaded into any of the several empty bins below the blending tower (Fig. 3). The loaded bins are then removed by fork-lift (Fig. 4) and taken into storage, from where the laboratory staff take samples from each bin for testing and evaluation. The loaded bins are taken from storage as needed in the processes and discharged one by one into a feed hopper. At this plant, although the bins have been in use for only a short period, it is apparent that labour costs have been reduced, for hand-dumping of smaller amounts, *plus* the extra handling between the various steps of the process was both time- and labour-consuming. Now only a few minutes is required to place the bins in position and let them self-discharge before removing them to storage and ultimately into process.

As titanium sponge is both a vulnerable and expensive raw material the use of the hermetically-sealed bins has enabled the American titanium sponge manufacturers to maintain the quality of their product and hence the quality of the components in which titanium takes its place.

Warren Spring Laboratory

The Department of Scientific and Industrial Research has announced that the Lord President of the Council (Lord Hailsham) is to open the new Warren Spring Laboratory at Stevenage on June 29 next. As readers will be aware the new laboratory is intended to assist Government departments and industry by resources that are not available in any other establishment of the Department. Its initial programme will include work on mineral processing, the synthesis of oils and chemicals from carbon-monoxide and hydrogen, and research aimed at the suppression of atmospheric pollution. Much of this work will be of a chemical engineering character and will require basic chemical engineering research to be undertaken in parallel with it. For the time being research on atmospheric pollution will continue at Greenwich.

A Note on Selenium

M. Schofield, M.A., B.Sc., F.R.I.C.

Properties and uses of an element usefully recovered from anode slimes.

Below sulphur in the chemist's classification of the elements lie selenium and tellurium, two elements which have met with contrasting fortunes as regards industrial application or adoption. While tellurium uses are potential rather than applied in commerce, selenium as by-product from copper refining has proved so versatile that the United States has found it necessary within recent years to draw on stockpiles to supply demands. Tellurium at one period was regarded as a boon in lead, with very small proportions so increasing strength that a rosy picture was painted of tellurium-lead adopted universally by the plumber for domestic piping resistant to the annual freeze-up. Such optimism has proved ill-founded, while on the other hand selenium has proved really versatile after losing its leading position in photo-electric cells.

The early development of selenium was based on the belief that sources of the element would be confined to flue dusts from roasting sulphide ores rather than in anode sludges, which constitute almost the entire source to-day. Selenium does occur as various selenides of copper-silver, of zinc-copper, and of lead, yet these are simply entered in the texts rather than proving of use to meet increasing demands in the electrical and metallurgical fields.

Its discovery by the Swedish chemist Berzelius began the first search for selenium in flue dusts from pyrites. Berzelius was seeking further sources of the sister element tellurium, which had attracted attention as a sediment in sulphuric acid plants in Sweden. Tellurium had been detected in a gold ore by a mine manager, Franz Muller, of Tyrol, this being followed by a full paper on the gold ores of Transylvania by the German chemist Klaproth, who named tellurium when he found it commonly present in such ores. Klaproth noted a vile odour as test for tellurium, so that Johan Gahn, that mining assessor who discovered far more than manganese, remembered a similar odour in the residues from sulphuric acid or vitriol plants where the sulphur dioxide came from roasting Fahlun copper concentrates.

With both Berzelius and his fellow countryman Gahn having a financial interest in a vitriol plant at Gripsholm, one which used as raw material pyrites from the famous Fahlun mines, the search for tellurium there brought instead selenium, named from " the moon " since Klaproth had named tellurium from " the earth." In 1817 Berzelius and Gahn believed they had found tellurium in a red deposit in the vitriol plant, a deposit formed whenever sulphur from Fahlun pyrites was used. They noticed a difference, however, in that the element studied in this case, though showing some metallic properties in some forms of the substance, could be sublimed like sulphur and in a flame gave a " strong smell of radishes." Berzelius thus stumbled on selenium and went further in oxidizing it with *aqua regia*, adding dilute sulphuric acid, separating the lead sulphate, and adding ammonia to the filtrate to give a selenium solution for studying further. Berzelius also noted that it was selenium present in Klaproth's tellurium which gave an unpleasant odour on ignition. The new element may well have remained a laboratory curiosity had not Willoughby Smith in 1873 opened up possibilities in the photo-electric cell, when he observed how the resistance of selenium decreased as the intensity of illumination of it increased.

With selenium an essential in glass manufacture, having new metallurgical applications, and with the almost universal selenium rectifier more than compensating for a very moderate outlet in photo-electric or " barrier layer " cells, the extraction of the element has now attained a high degree of efficiency. Up to a 1,000,000 lb. weight of selenium represents the output from half a dozen American and Canadian producers, the Statistical Summary for 1951–56, published by the Mineral Resources Division of the Colonial Geological Surveys, giving some indication of the constant demand for selenium by Britain, in contrast to the ever-increasing output by

United States producers. Thus from 1946 to 1952 British imports fluctuated moderately from 168,000 lb. to 178,500 lb. per year, while in the same period American production had increased from 291,000 lb. to over 687,000 lb. Canadian figures became rather less than 300,000 lb. produced annually, while Sweden, as the birthplace of selenium, maintained a steady yield of rather less than the 100,000 lb. Additional sources are constantly being studied, Noranda Mines, Ltd., providing one instance where a small-scale plant was used for roasting pyrites for producing sulphur and recovering selenium if a suitable method could be found for modern extraction, recalling the first search for selenium by Berzelius.

In Sweden the Boliden Mining Company works up anode slimes for selenium, in Belgium the producers are the Société General, while in Australia the Electrolytic Refining and Smelting Company have produced selenium for some years.

According to the variation in anode sludges the technique of selenium recovery has varied. A soda smelting process uses soda and silica for fusion with the de-copperized raw material, any slag being removed before rabbling the fused charge with air and trapping any volatilized selenium in a Cottrell unit. Caustic soda and saltpetre are added to the mass within the furnace, the resulting slag being crushed, leached with water, tellurium removed by adding sulphuric acid, and the selenium now precipitated by use of sulphur dioxide. A second extraction depends on roasting with soda to well below sintering point, the selenium being oxidized and sodium selenate in the extract with water being evaporated. This selenate is then reduced to sodium selenide by carbon, the mass dissolved, and the solution blown with air, selenium being recovered as before by precipitation with sulphur dioxide.

One of the most efficient processes was that adopted by Germany during the war and is described in the F.I.A.T. Final Report, No. 750 of 1946. In this extraction method the raw slimes from copper refining are charged into a furnace usually with the addition of lead, the selenium being volatilized and caught in a Cottrell with scrubber system. The insoluble free selenium is returned to the furnace. The solution in the scrubbers is maintained at 150 g. per litre of free sulphuric acid and the selenium is permitted to build up to 150 g. per litre. By maintaining this recovery by acid all the selenium dissolved is in the selenic form. To the resulting solution after filtering is now added 20% by volume of 19° Be hydrochloric acid, after which sulphur dioxide is used to bring down the selenium. There follow filtering and washing with dilute hydrochloric acid, the selenium now being fused, cast, crushed, and ground to give a commercial product of up to 99·5% selenium in the better grades. Selenium appears on the market as " high-purity " element, used almost entirely for the electrical rectifier industry and being as high as 99·99% in the " ARQ " rectifier shot. The commercial grade as lump or powder is round about 99·5% and goes into glass and chemical uses, as well as into pigments. There are also marketed selenium dioxide, both high-purity and commercial, and ferro-selenium for the steel industry.

Coming now to the ever-increasing variety of uses in commerce for this by-product of copper refining, the older use in the glass industry may be noted first, since it is still an essential. The first application here is in additions up to 0·007% of selenium in ordinary grades of white glass to mask the green tints due to iron in the melt. Though the proportion is so small the total selenium used is considerable, since all sands used in glass production contain varying amounts of iron. Selenium is preferred to manganese dioxide for decolorizing, since the glass has a superior brilliance and there needs to be more control with manganese of oxidizing conditions. Suggestions that tellurium may prove useful in this field have proved useless as an outlet for this closely related element to selenium. Crystal-clear glass for a vast output of bottles and jars for cosmetics, pharmaceuticals, foods, and drinks depend on selenium decolorizing for their " white " or completely colourless properties demanded by the trades concerned.

The second large-scale application of selenium in glass is to produce ruby glasses for car rear-lamps, railway signals, ships' lamps, and lamps for wing-tips for aircraft. At one period ruby glasses made by including copper or gold in the batch were known, yet this old craft seems to have disappeared. The rare element neodymium also imparts a red colour to glass but is uneconomical, while deep red plastic covers for car rear-lamps, though at first apparently a serious rival to selenium ruby glasses, have been found inferior to glass as regards " scratchability " and because plastic lenses for rear-lights may become affected by the heat of the lamps. In

this application three times the total quantities of selenium are used than in white glass, since the proportion of the element in a deep ruby glass may be of the order of 2% to 3%.

The characteristic of selenium of imparting a red colour to materials is seen in the pigment industries and even in the paint industry in the United States despite the high cost. Combined with cadmium in "cadmium-selenide" reds or "cadmium seleno-sulphide reds," as they should be called, the colours obtained range from orange tints when cadmium sulphide predominates to a dark red or maroon. They are produced by co-precipitation of sulphide and selenide by adding sodium sulphide *plus* selenide and there are also cadmium-seleno lithopones used in the American paint industry for superior non-fading reds and prepared by co-precipitation with barium sulphate. In the plastics industry in particular selenium-cadmium reds are often preferred, since a marked advantage over organic pigments is claimed in non-fading, heat-resisting, and in being less resistant to chemical reaction. In vitreous enamels for pottery and glass, in pigments for rubber, as in the well-known hot-water bottle, and in other fields selenium reds are in wide use. In the rubber industry there is a further outlet since selenium in vulcanizing is claimed to impart resistance to heat, abrasion, and oxidation.

During the last 20 years selenium has entered the metallurgical field, particularly in the United States, following the discovery that selenium additions to stainless steel not only aided de-gasification but also improved machinability. In other countries such an application has not been further developed due to appreciable cost when selenium supplies are imports; an exception is in the copper industry for improving machinability of copper alloys as in British Patent No. 466,675 for example. Selenium additions, in conjunction with aluminium, in steels and other specifications all indicate the efforts to find metallurgical uses despite the cost. Such uses in the metal trades are distinct from efforts to use free selenium as a corrosion-resistant coating on aero-engine parts, on magnesium alloys made resistant to sea-water by a red selenium coating, and as a flame-proofing agent for switchboards.

Among many other demands for selenium in industry are those in the electrical field, with the selenium photocell or "barrier layer cell," well known in photographic exposure meters. This has a thin film of metallic selenium deposited on a metal surface with a transparent film of a rare metal on top of the selenium, the resistance decreasing with increase in light energy falling on the cell.

The older photo-electric cell requires an external source of current, depends also on change of resistance with radiation falling on it, but is unsuitable for accurate measuring instruments. These electrical applications of selenium have now become almost insignificant compared with the selenium rectifier, by now almost the only type of metal-plate rectifier in universal use. The rectifier depends on a semi-conducting layer like selenium or cuprous oxide deposited on a metal plate so that the current flowing through the junction meets with a low forward resistance and a high reverse resistance. To-day in place of cuprous oxide or magnesium sulphide selenium has become widely adopted, following a German development prior to World War II. A base-plate of aluminium or nickel-plated steel has deposited on it a selenium layer by direct pressing or vacuum distillation, this layer being covered with a counter-electrode of cadmium-bismuth or cadmium-bismuth-tin alloy. The selenium rectifier proves efficient over a wide temperature range and has resulted in selenium being an essential in defence programmes of the chief powers.

Selenium dioxide is an invaluable catalyst, used in the manufacture of cortisone and of nicotinic acid, thus demonstrating yet another application of this by-product of copper refining.

Survey in Angola

Some details of an airborne prospecting survey of oil potentialities in Angola have recently been released by Hunting Geophysics, Ltd. This survey, which was scheduled for completion by the middle of January, covered a coastal strip, extending offshore at some points for up to 60 km., running from about 4° 30′ S. (just above the border of French Equatorial Africa) through the seaward tip of the Congo to 10° 30′ latitude, a few miles north of Porto Amboim. Flying at 3,000 ft. so that near-surface magnetic effects did not mask those of deep-lying rock structures, the survey DC-3 aircraft covered the area in a series of parallel traverses, at a line spacing of 2 km., totalling some 18,000 miles.

Compressed-Air Systems[1]

Leo Walter, M.Inst.F.

A discussion of the importance of maintaining efficiency

Instrumentation

In older compressed-air systems correct and highly desirable instrumentation is often either non-existent or inadequate. The wider use of rate-of-flow meters has already been mentioned and another very useful signal device is a simple flow indicator (Arkon and others) which enables the engineer to see at a glance if something in a compressed-air pipeline has gone wrong, or if cooling water flow to the compressor cylinder jacket is not as it should be. Progress in design of orifices or pitot tubes makes the use of flowmeters based on pressure differential a good proposition, while area flowmeters using the principle of a floating cone are now available from several makers in this country. Their installation direct into a pipeline is simple and they are sturdy straightforward instruments which may also be equipped with an alarm.

[1] Concluded from the February issue, p. 90.

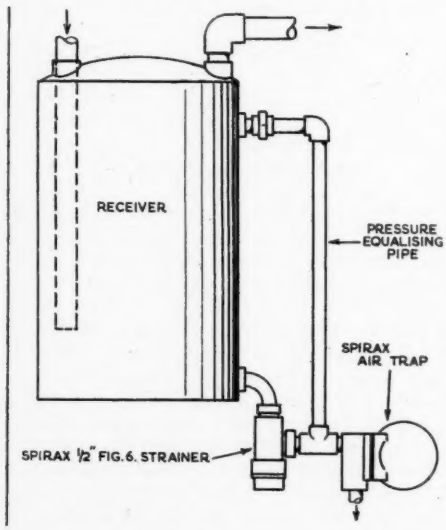

Fig. 5.—Air Trap on Receiver.

The most widely used instrument in compressed-air systems is the dial pressure gauge. The first point to be considered is the choice of an indicator having a large dial with bold figures and pointer, which produces good visibility. The latter also makes it desirable to install at eye level and otherwise to have the dial at an angle at which the plant operator can see at a glance the pointer location without exertion. For example, if installed under the ceiling the gauge body should be set forward at a slight angle so that the dial is at a right angle to the line of vision. The pressure tapping should be at the top of the main or vessel, thus avoiding accumulation of sludge or scale at the tapping point. Stainless-steel small-bore tubes are preferred for higher pressure, otherwise $\frac{1}{4}$ in. to $\frac{3}{8}$ in. copper tube can be used. A stop valve at the point of tapping permits dismantling and cleaning of the impulse pipe.

Usually an isolating cock is fitted at the gauge itself for zero test. In order to fit a test gauge easily a pipe tee should be fitted to the gauge with removable plug.

The greatest enemies of accuracy of pressure measurement by means of dial gauges are : (1) Dirt in pipelines, (2) water or oil in the piping system, (3) heavy and frequent pressure fluctuations, and (4) vibration. It has already been mentioned how to deal with (1) and (2). Heavy pressure fluctuations put great strain on the internal mechanism of a gauge and some damping means should be inserted between gauge and pressure pipe in order to smooth out excess changes. A simple needle valve, a restriction screw, or a length of small-bore tubing can sometimes produce the desired damping effect.

Fitting a pressure vessel is also recommendable to produce an additional capacity. As shock absorber the use of a check valve or of a labyrinth is also advisable for sudden

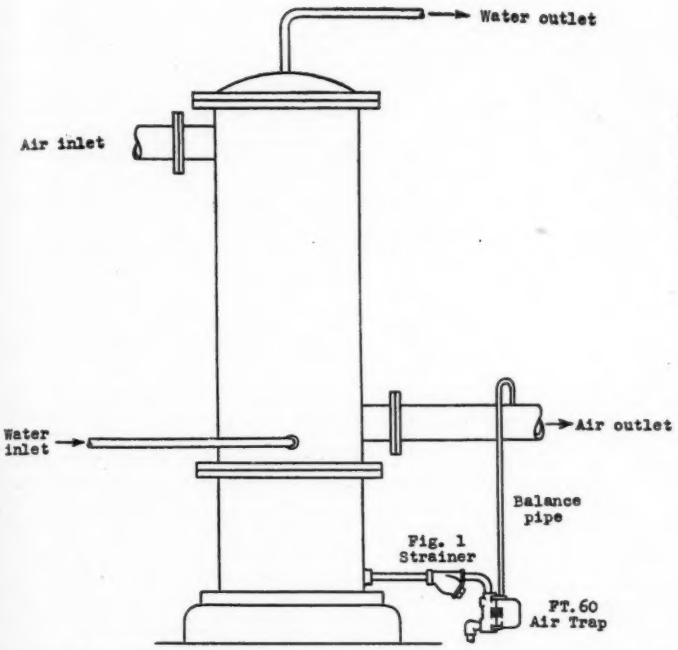

Fig. 6.— Air Trap Draining After Cooler.

pressure shocks of short duration. Quality gauges have an overload device incorporated in their design in order to avoid distortion of the pressure-sensitive element. For example, the well-known Bourdon tube can be protected by applying an outer ring against which the tube bends and is stopped when excessive strain is placed upon it.

Inaccurate pressure gauges or measuring instruments in general can often cause less efficient plant operation and it cannot be over-emphasized that frequent checking of each single instrument is necessary. A pressure gauge must read zero when subjected to atmospheric pressure and if the simple zero test is not satisfactory the instrument must be repaired. A dead-weight tester is a convenient means for testing manometers and where the number of gauges in use warrant it this not expensive testing outfit should be available in the maintenance department. When a low-priced gauge fails it is, however, advisable to buy a new one instead of going to the expense of repair and recalibration.

Taking Moisture Out

A survey of older existing compressor plants and distribution systems nearly always discloses presence of excess moisture at the points of uses of compressed air. To use draincocks at critical points is useful but their efficiency depends on the human plant operator. Compressed-air drain traps work automatically and do the job better (Fig. 5). The illustration shows the installation of an air trap on a receiver. Other points of drainage are the intercooler and the aftercooler (Fig. 6). Often the surface of the mains acts as cooling surface and adequate fall of the pipes should lead to drainage points. Air separators located strategically provide elimination of moisture provided that the right type and size of air trap is installed and correctly fitted. Fig. 7 illustrates a self-made air-filter type at a point of use, made from an old globe valve body. An air trap (not shown) will drain the moisture. In a workshop or building the distribution should preferably be performed by a ring main (Fig. 8). A fall of not less than 1 in. in 10 ft. in direction of the air flow is recommended (Spirax method).

Wider Use of Airbreakers

The increased use of compressed-air breakers in this country draws the attention of mining engineers to earlier experiments.

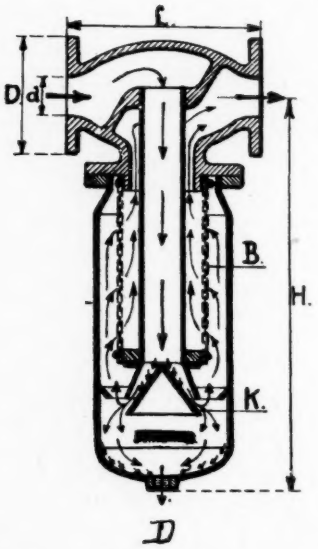

Fig. 7.—Improvised Filter : B—Bronze Gauge Cylinder ; K—Repulse Cone ; D—Drainage Point.

A brief description is given in the following by permission of the N.C.B. (1)[1]; The Armstrong airbreaker used in the tests is of American design, but the "Airdox" type works similarly and is made in this country.

The first tests with an Armstrong airbreaker were performed at Bank Hall colliery in 1955. The system used consisted essentially of an electrically-driven air-compressor operating at pressures up to 12,000 p.s.i., and of pipelines for conducting the high-pressure air to the coal face. Shells are used for discharging the air in shot-holes in a way similar to Cardox. The compressor used in these experiments was a six-stage machine with horizontally-opposed cylinders. A 90-h.p. motor running at 1,460 r.p.m. was fitted. Fig. 9 illustrates the compressor house for this airbreaker installation. It has been officially stated that the use of the airbreaker at Bank Hall has resulted in increases in output per filler and aggregate output from the face.

The use of airbreaker equipment in other branches of mining seems to promise advantages as compared with conventional mining methods. The use of very high air pressures may, however, sometimes cause difficulties in pipeline maintenance and the like.

Novel Air-Compressor

A brief comparison between reciprocating and rotary compressor types has already been given. The increasing number of firms which have added rotating compressor designs to their range indicates the growing importance of this compressor type. There is, however, a third type of air-compressor being developed for which their makers claim great benefits for users. This type uses a free-piston gasifier for air compression and stationary or mobile units are available.

One British licensee specializing in air

[1] References are given at the end of this article.

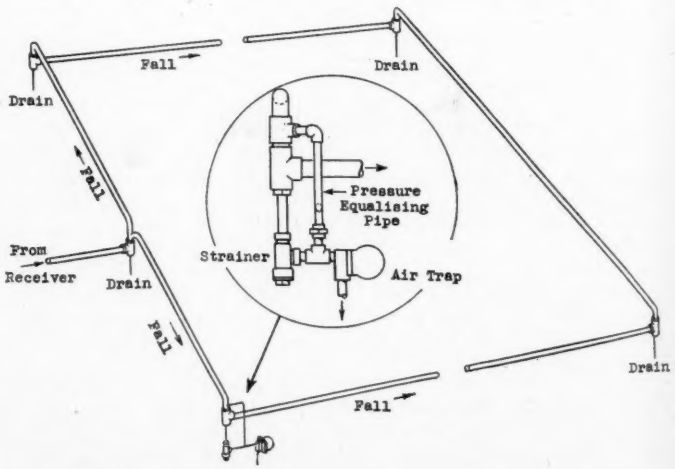

Fig. 8.—Arrangement of Ring Main in Workshop.

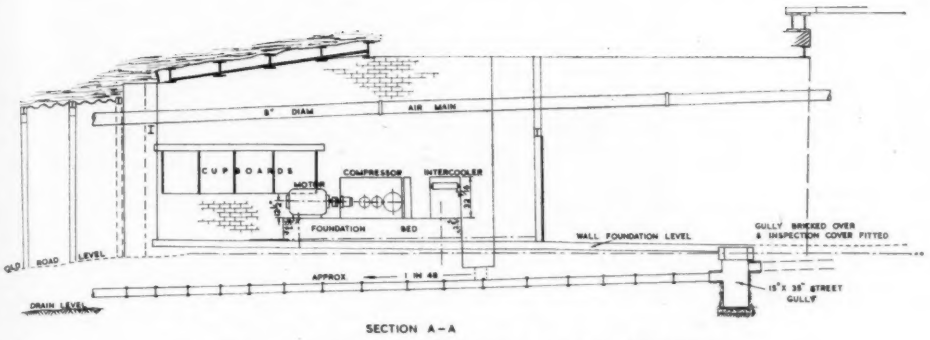

Fig. 9.—Compressor House for Airbreaker Equipment.

compression units are Mackay Industrial Equipment, Ltd., of Feltham, Middlesex. The work done in the Mackay stationary or mobile units is performed by opposed diesel pistons directly converted into energy in the form of compressed air. The type DAC 130 has only one diesel cylinder, connected at one end to the compressor cylinder and at the other end to a cushion cylinder (Fig. 10). Each cylinder is independently detachable and replaceable. High efficiency for air compressors is achieved (Fig. 11).

Another notable development is the German-made Junkers free-piston air-compressor design, marketed in the British Commonwealth by Acrow, Ltd. A special Junkers is type 4FK 115 AK, which is a four-stage compressor producing up to 4,200 p.s.i. pressure and an output of 64 cu. ft./min. These pressures have uses in the chemical and heavy oil industries besides many others. The type is available in stationary side-mounted and portable types. A notable feature of all Junkers machines is a synchronizing mechanism between piston groups consisting of racks and pinions. These and the pistons themselves are virtually the only moving parts.

One company gives the following reasons for interest in similar plants: In a multi-gas-generator compressor plant individual gas-generators can be shut down for maintenance without interruption of the operation of the plant as a whole. A proportion of one gas-generator in four or six is all that need be provided for standby equipment to permit continuous operation of the plant throughout the year.

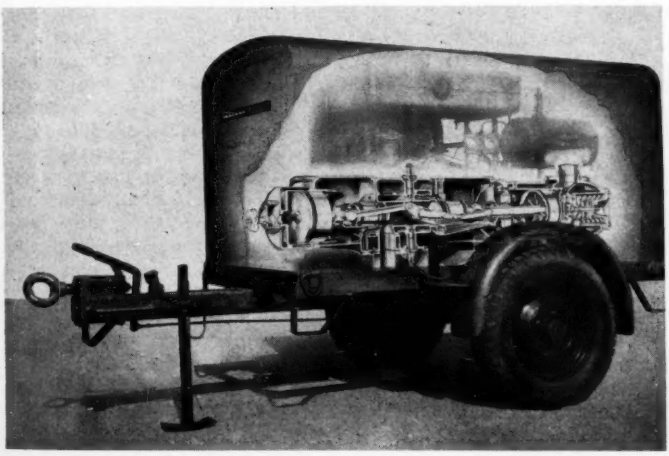

Fig. 10.—Direct-Air Free Piston Compressor.

(Mackay Industrial Equipment, Ltd.)

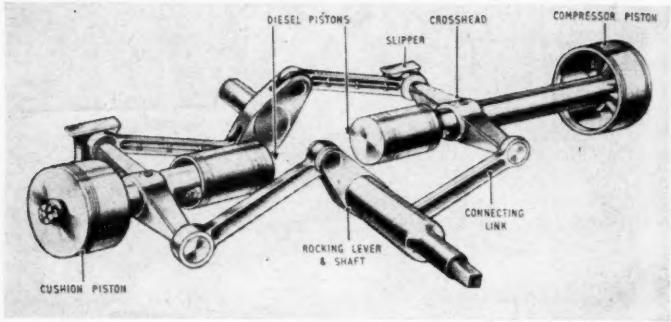

Fig. 11.— Moving Parts of Free Piston Compressor.

Owing to the high maximum temperatures and pressures in the cylinder and the large amount of excess air the free-piston gas-generator is particularly well adapted to burning a wide variety of liquid fuels (including heavy residual oils and crude). The engine is comparatively insensitive to the fuel which may be changed with very little, if any, adjustment to the plant.

The author's acknowledgment is due to the National Coal Board and to the various firms mentioned for data and illustrations.

Bibliography

(1) Inform. Bull. N.C.B. No. 56/177. The Armstrong Airbreaker at Bank Hall Colliery.

(2) Spirax-Sarco, Ltd., Cheltenham. Spirax Information Sheet No. 17 : Compressed Air.

Tanganyika Mining Industry, 1958

A brief review by the Commissioner for Mines

For a number of reasons the year 1958 was a notable one in the history of mining in Tanganyika. Overshadowed as it was at the outset by the untimely death in January of the industry's most outstanding personality, the late Dr. J. T. Williamson, discoverer of the world-famous Mwadui mine and founder of Williamson Diamonds, Ltd., the year saw new production records set and at least two important new mineral discoveries made—a large deposit of phosphate in Mbulu district and extensive beds of rock salt in association with anhydrite and gypsum in the Kilwa district.

Mineral Production

For the first time the annual value of mineral production surpassed the £6,000,000 mark. When all outstanding account sales, smelter, and other returns have been received and evaluated it is likely that the final figure will exceed £6,600,000, which represents an increase of more than £1,100,000 over the preceding year. Although the increase was due to a larger diamond output there was a remarkable expansion in salt production and increases were recorded in the output of coal, garnet, gold, kaolin, lead concentrates, lime, "magnesian bentonite," magnetite, meerschaum, waste mica, tin concentrates, and vermiculite. In the case of only three products of any consequence was the output lower than in 1957; these were building minerals (stone, gravel, sand, etc.), raw gypsum, and sheet mica.

Progress was made in the development of what are virtually two new mines—the Kaborishoke tin mine, in the Karagwe district, and the Kiabakari gold mine, Musoma district. At both properties mill

plants with a capacity of about 1,000 tons and 700 tons a day respectively were under construction and will come into production shortly. This should result in a marked increase in the country's tin, gold, and silver output.

An event likely to be of substantial benefit to the economy of Tanganyika for a long time to come was the acquisition in August by the Government, jointly with De Beers Consolidated Mines, Ltd., on a fifty-fifty basis of the entire share capital of Williamson Diamonds, Ltd. With this deal went the control of Buhemba Mines, Ltd., by virtue of Williamson Diamonds' majority shareholding. Buhemba Mines, Ltd., owns and operates in Musoma district what is at present the territory's second most important gold mine.

Corundum (*Ruby*).—The precious stone, ruby, is a transparent, coloured variety of the mineral corundum. A deposit of corundum in association with zoisite in an attractive dark or apple green rock is believed to have been first noted during digging-in operations by the Germans in the Masai district, near the Kenya frontier, during the first world war. Claims were pegged by a prospector in 1948 but there was little activity until they were acquired by the Tanganyika Corundum Corporation, Ltd., in 1958. Investigations by the company have disclosed the presence of ruby corundum crystals, some of which are of near-precious quality. The deposit is being developed and during the year experimental exports were made, both of crystals for the jewellery trade and of the associated green rock, which is of value for art work, such as ash trays, desk sets, bijouterie, etc. It would seem not impossible that rubies may yet appear among Tanganyika's exports of precious stones.

Diamonds.—With the achieving of full-capacity throughput at the new treatment plant of Williamson Diamonds, Ltd., production reached a new high record, with exports of rough stones totalling approximately 515,762 carats having an estimated value of £4,391,000. This represents an increase of 143,160 carats in weight and over £1,149,000 in value compared with the 1957 figures. The whole of the production came from the Mwadui mine of Williamson Diamonds, Ltd., except for 13,778 carats, valued at approximately £116,400, exported by Alamasi, Ltd., from their adjacent property.

Gold and Silver.—The downward trend of production in the gold-mining industry during the past three years was arrested and for the first time since 1954 the output of gold from this source took an upward turn, though the amount of associated silver was slightly less than in 1957. Exports in terms of metal refined from mine bullion amounted to 56,299 oz. of gold and 18,552 oz. of silver, worth £705,180 and £5,887 respectively. In addition it is estimated that final returns will show a recovery of some 10,000 oz. of gold and more than 500,000 oz. of silver from the smelting of lead concentrates from Mpanda mine.

There were some anxious moments during the year about the future of the Geita mine, the largest gold mine in East Africa, which was experiencing poor mill recovery and financial difficulties. However, with the solving of the metallurgical problems and the adoption of a reduced milling rate, together with financial reconstruction within the group, matters assumed a somewhat different complexion and by the end of the year the gold output had exceeded that of the previous year despite a reduced tonnage treated. For this result great credit is due to the mine management.

Reference has already been made to the Kiabakari mine, in the Musoma district. Apart from this property and at Buhemba mine, where operations continued at a normal level throughout the year, mining activities in the Musoma and North Mara goldfields were on a small scale. There was, however, a slight revival of interest in the possibilities of the Musoma district, including the auriferous areas of the Kilimafedha (Serengeti) region where mines and prospects have been worked from time to time since the period of the former German administration.

Elsewhere in Tanganyika gold-mining activities were on a restricted scale. The whole industry continued to be gravely handicapped by the fixed price of the metal and there can be little hope for a material brightening of the picture generally until a more realistic price is obtainable.

Lead.—Exports of lead-copper concentrates by Uruwira Minerals, Ltd., from Mpanda amounted to 13,501 metric tons, valued provisionally at £972,000. This was an increase of 876 tons over the 1957 exports and the price realized per ton was slightly higher.

Meerschaum.—Just under five tons of this interesting and rare mineral was exported to their Nairobi factory by the Tanganyika

Meerschaum Corporation, Ltd., from claims in Masai district. It is from this " feather-weight " mineral that the attractive and increasingly popular Amboseli meerschaum tobacco pipes are manufactured. There is an expanding demand for these articles both in East Africa and overseas.

Mica.—Exports declined by approximately 18 tons in weight and £18,000 in value compared with the preceding year and amounted to 48½ tons of sheet, the estimated value of which was £51,226. Ten and three-quarter tons of waste mica valued at £104 was also exported.

Niobium.—At the Panda Hill pyrochlore (niobium) mine the Mbeya Exploration Co., Ltd., continued the pilot-plant production of concentrates for export to Holland, where experimental work on the making of a good-grade marketable product is in progress at the Arnheim works of N.V. Billiton Maatschappij, a parent company. A decision is expected towards the end of 1959 as to whether this undertaking is to be developed into a large-scale producer.

Salt.—Owing to prolonged spells of dry weather and scanty rainfall in the coastal regions salt production by the 12 sea-water solar evaporation undertakings collectively reached an all-time high record with 17,989 tons. At the inland works at Uvinza, near Kigoma, where brine from a spring is evaporated in fire-heated pans, a new record was also set (for the tenth year in succession) at 17,570 tons. The total territorial production for the year, including the Ivuna salt works at Lake Rukwa, was 35,797 metric tons, which exceeded the previous highest figure (in 1956) by 7,480 tons. This does not take into account an appreciable output by Africans using primitive methods to supply their own requirements, more especially in the region of the salt lakes of the Central Rift area.

Exports, chiefly to the Belgian Congo, totalled 8,849 tons valued at £89,129. Sales within the territory amounted to 20,735 tons, worth £153,882.

Tin.—The position at the Kaborishoke mine of the Kyerwa Syndicate, Ltd., has already been mentioned. Production at this mine remained suspended throughout the year while construction of the new mill proceeded. Elsewhere in the Karagwe tinfield small-workers' activities were seriously handicapped by water shortage owing to lack of rain. In spite of this there was a small but welcome increase of 6 tons in the quantity of cassiterite concentrates exported, the total being 26·2 tons, having an estimated value of £13,471.

Prospecting

At the close of the year 19 exclusive prospecting licences were current in respect of minerals, other than mineral oil, over a total area of 34,548 sq. miles. The largest single area held under exclusive licence is one of 34,000 sq. miles in Western Tanganyika, where widespread prospecting operations employing modern scientific methods were actively pursued throughout the year by Western Rift Exploration Co., Ltd. (the Anglo American group and associates).

A large phosphate deposit which may well prove to be of major importance as a source of fertilizer was discovered by New Consolidated Gold Fields, Ltd., when prospecting for other minerals in an area held under exclusive licence 70 miles south of Arusha. A small pilot plant was installed for research into the best method of beneficiating the mineral. Proving of the deposit is proceeding. This company also applied for a special exclusive prospecting licence in the Karagwe tinfield.

The third East African deep test well (the second in Tanganyika) was " spudded in " on March 28 at Mandawa, between Kilwa and Lindi, by BP-Shell Petroleum Development Co. of Tanganyika, Ltd., and by the end of the year had reached a depth of 12,711 ft. Important thicknesses of rock salt in association with anhydrite and gypsum, which will be available for exploitation at a later date, were penetrated in the boring. Elsewhere in the coastal region the company's geological, geophysical, topographic survey, and stratigraphic drilling parties were active. It is estimated that about £1,350,000 was spent on this work during the year, bringing the total expenditure by the company on prospecting in Tanganyika to over £4,250,000 since the commencement of operations in 1952.

At the close of 1958 there were (provisionally) 548 holders of current prospecting rights, of which 202 were Africans. In addition to the 19 exclusive prospecting rights already mentioned as covering 34,548 sq. miles, there were current one oil exploration licence over an area of 24,920 sq. miles, one oil prospecting licence in respect of an area of 380 sq. miles, and 2,618 mining claims and leases covering a further 245 sq. miles. The total area thus held on December 31 amounted to approximately 60,093 sq. miles.

Shunting in Tandem

C. F. Carter [1]

Use of two locomotives and shunting economy

Advantages in the use of multiple-coupled locomotives for main line haulage duties have been proved for a number of years and these same advantages can be applied to the use of tandem machines for certain shunting duties. It should be remembered that this tandem plan cannot be justified for all duties any more than the use of multiple locomotives can be justified on all main lines, but in many applications the tandem plan here outlined will prove a solution to complex shunting problems.

The economies of shunting are such that the most attractive operating cost figures are achieved when the right size of machine can be selected for the duty and when the maximum utilization of these machines can be obtained. The majority of shunting yards have varying duties demanding different powers for different hauls and, if machines were purchased to perform the heaviest duty as a standard, utilization at the lighter duties would be low with consequent reflection in high shunting costs. Even if machines of varying sizes were acquired and some degree of standardization achieved the standby locomotive must be capable of covering the heaviest duty, thereby giving a high first cost and standby cost as well as poor utilization because such machines are virtually single-purpose units.

In many applications the use of the tandem scheme will eliminate these problems. Take for instance a steel plant at present operating 14 in., 16 in., and 18 in. cylinder bore steam locomotives. Analysis of the work is likely to reveal that the duties can be split into two categories—*i.e.*, 200 h.p. and 400 h.p. in a probable ratio of 5 : 2. In such a case ten Ruston Mark 200DE locomotives, each rated at 210 b.h.p., arranged for tandem operation would be ideal even if the two 400-h.p. duties were continuous. Two pairs of machines would remain almost permanently coupled while five machines would be out on general duty. The spare machine would provide standby cover for both duties and facilitate routine maintenance without any loss of

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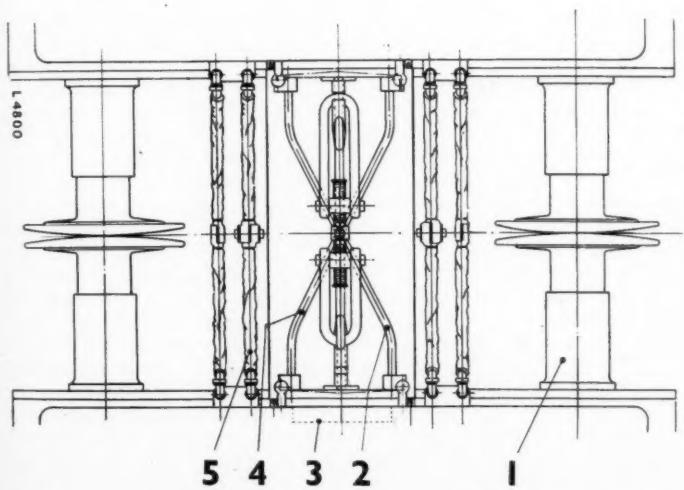

Fig. 1.—Coupling : (1) Buffers ; (2) Engine Speed Control Pipe ; (3) Rear Cab Door ; (4) Air Pressure Balance Pipe ; (5) Brake Air Pipe.

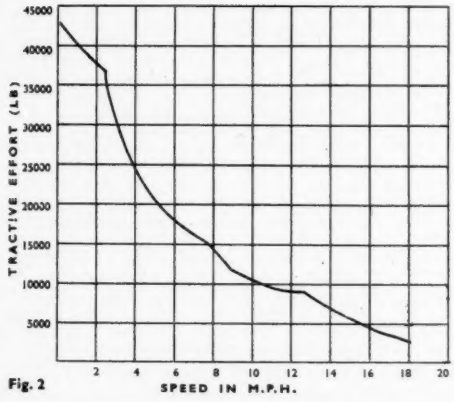

Fig. 2

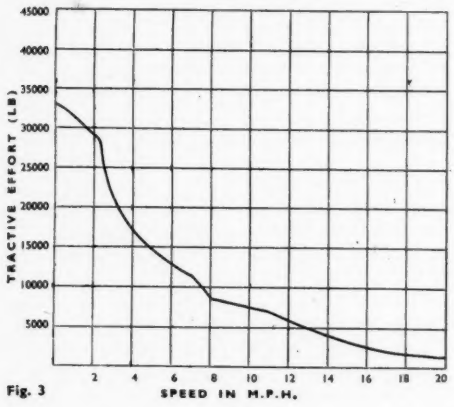

Fig. 3

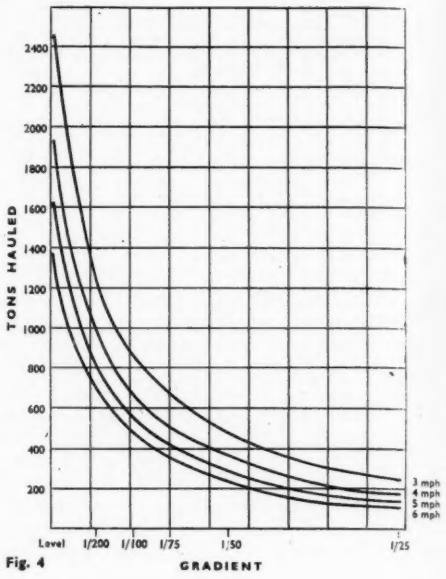

Fig. 4

Fig. 2
Tractive effort 200DE Tandem (normal temperature and altitude)

Fig. 3
Tractive effort 165DE Tandem (normal temperature and altitude)

Fig. 4
200DE Tandem haulage capacity

traffic. The first cost of this fleet of ten 200DE locomotives would obviously be more attractive than the three 400-h.p. units and five 200-h.p. units which would otherwise be necessary.

A number of mines or quarries may feed to a central screening or processing plant with each feeder requiring 150 or 200 h.p. However, the final plant output may have to be hauled to the main line either in larger trains or over more adverse gradients requiring 300 or even 400 h.p. Again this is an instance where the tandem plan would show a definite cost and flexibility advantage over other schemes involving a mixed bag of machines.

Achieving Balanced Operation

How is the balanced operation of two diesel-electric locomotives achieved? First, it must be appreciated that each diesel engine is set to give a maximum horsepower at a predetermined speed and consequently the torque-speed and horsepower-speed performance of each unit will be similar. In the type of design used on the Ruston locomotive, with British Thomson-Houston electrical equipment, the generator has a steeply-drooping characteristic and is very sensitive with speed. On maximum load demand the engine speed will be pulled down, due to this loading. This reduction in speed will also apply to the generator which is direct coupled and thus the voltage is reduced to a balancing point. This characteristic is set on each locomotive for a predetermined engine speed drop and consequently generator output curves are similar. It will now be seen that by the use of balanced pneumatic controls, working on the engine speed lever, a balanced output of power between two locomotives can be achieved. The normal power lever can

therefore be used on each locomotive operating on the pneumatic valve and a flexible air hose with screw connexion used between the two machines. To transfer the power control from one machine to another it is necessary to turn a two-way cock through 90°.

In normal diesel-electric locomotives reversing is performed mechanically and this is not possible with the tandem locomotives. It is therefore necessary for air pressure to be used to throw reverser switches, the control being arranged through electro-pneumatic valves. A multi-core cable is used between the two locomotives with multi-pole sockets and plugs for this and the other electric controls which will be described later.

Controls

The brake control valve incorporates a special feature as for train braking which on application releases a graduated and equal pressure to the brake cylinders on each machine, thus giving an even degree of application to each wheel of the tandem unit. In this case the coupling between the two locomotives consists of two flexible pipes with snap connexions, these pipes being duplicated to either side of the locomotive for convenience. The second flexible pipe is for the emergency feature, which, in the unlikely event of a mishap causing the two locos to break away, would cause the brakes on both machines to be fully applied. To hand over the brake control from one locomotive to the other it is necessary to drop a catch on the brake valve and lift the operating lever to the handle off position, which is above the normal release position.

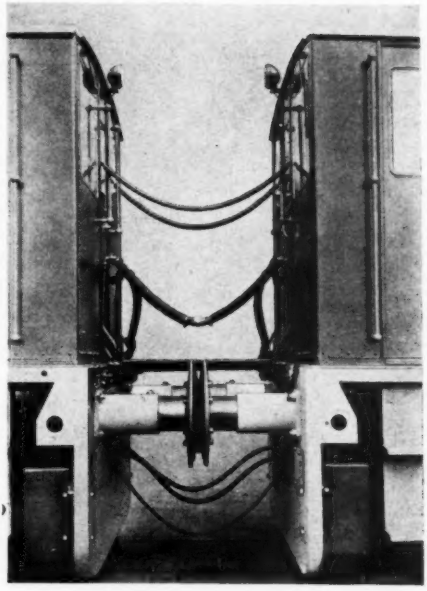

Fig. 5.—View of Coupling Arrangement.

Sanding is arranged in the usual way with air ejection from the sand boxes and with a second ejector in the lower portion of the

Table 1

Haulage Capacities of Ruston Tandem 165DE Locomotives (56 Tons)

Speed m.p.h.	Tractive effort, lb.	Drawbar pull, lb.	Load hauled on straight track, tons						
			Level	1/400	1/200	1/100	1/75	1/50	1/30
From Rest	32,700	31,692	1,760	1,330	1,063	755	626	465	297
2·8	21,500	20,828	1,735	1,165	870	570	456	322	192
4·5	15,000	14,328	1,195	795	590	380	302	208	117
6·0	12,500	11,828	985	654	482	307	242	164	88
8·0	8,600	7,928	660	432	315	194	149	95	42
12·0	5,450	4,778	398	254	179	102	74	40	—
15·0	3,120	2,448	204	121	78	34	18	—	—
18·0	1,950	1,278	106	54	28	—	—	—	—
20·0	1,560	888	74	32	—	—	—	—	—

Performance

583 lb./ton adhesion required for 32,700-lb. starting tractive effort. 383 lb./ton adhesion gives 21,500 lb. tractive effort at 2·8 m.p.h. Loads indicated are based on a starting resistance of 18 lb./ton and a rolling resistance of 12 lb./ton.

Fig. 6.— Locomotives in Tandem.

sand pipe. Control however is by electro-pneumatic valves operated by pressbuttons which are arranged at either side of the cab. The electric controls are connected through the multi-core jumper cable between the two locomotives.

It will be seen from the above that air pressure is used on a number of controls and to ensure the simultaneous operation of these on the two machines pressures must be similar. Therefore an air pressure balancing pipe is used between the two units which ensures that unloading and loading of compressors occurs simultaneously and that an equal working pressure is available on both machines.

The arrangement of connexions is shown in Fig. 1, which indicates the simplicity of this arrangement. Locomotives can be coupled and ready for service in tandem in under 10 minutes.

Driver's Facilities

In order to ensure easy and safe working it has been necessary for the design engineers to arrange for the provision of improved visibility in the driver's cab and this has been achieved by incorporating windows beside the bonnet, which enable the driver to see the buffer faces of the trailing locomotive and the first wagon clearly, and also central windows in the centre of the front and rear of the cab, eliminating a possible blind spot. A door is also provided at the rear of the cab with a walk-over platform so that the driver can move easily from one machine to the other when required. It should be pointed out here that in practice drivers do not change over cabs to reverse on to a train, due to the fact that the visibility is so good they can observe shunter's signals and see the buffer faces without difficulty.

Performance Curves

Performance curves for the 200DE and 165DE tandem units are shown in Figs. 2 and 3. These show tractive effort speed curves. In Fig. 4 are performance curves for a 200DE tandem locomotive operating on various gradients, from which it will be observed that almost 1,000 tons can be handled at 4 m.p.h. against a gradient of 1 in 200.

First Tandem Installation

The first tandem installation was that at Colvilles' large new Ravenscraig steelworks near Motherwell, Scotland.

One pair of tandem locomotives is used for hauling special transfer cars in sets of eight cars, each car carrying two 13-ton ingots from the melting shop to the Dalzell rolling mill 1 mile distant over adverse gradients. Another pair of locomotives operate the ladle carriage duty from the blast-furnace, transferring iron to the melting shop. A third tandem set operates in the main goods yard, bringing into the works heavy trains of materials and hauling out finished steel products. Other units operate as single locomotives throughout the works.

Many readers will be familiar with the advantages of the diesel-electric transmission which affords such excellent service with such precise and infinitely variable control. The outstanding success of these Mark 165DE and 200DE locomotives will, it is suggested, continue and be enhanced by the tandem control feature now developed, ensuring that the economics of shunting are considered to the full.

Ore-Dressing Notes

(9) *Tailings*

Stope Filling

Where suitable, mill tailings provide a cheap and readily available source of backfill and one which is readily introduced and manipulated hydraulically; their use in this way can also reduce the need for surface storage. This material involves no fire risk, is readily and permanently settled, and thus compares attractively with timber which must be handled through shafts and levels, put in place by skilled labour, and renewed if subsidence is to be avoided. Against these and other advantages are the risk of sand seepage and of failure to drain and consolidate after hydraulic stowing.

To be suitable for use the sand must be free from potentially noxious or dangerous gases—such as, hydrogen cyanide—while the possibility of oxidation and heating through decomposition of sulphides must be considered if it could lead to fire or air pollution. Otherwise chemical action may be of advantage if it helps to consolidate the settled sands. The sand must be sufficiently free from slimes to drain readily *in situ*, yet must be readily transportable and have stable packing characteristics. In general terms desliming must remove the bulk of the *minus* 15 micron particles and leave the material with a draining (or percolating) rate of several in./hour. For transportation the pulp should not contain high-density minerals and the slurry should consist of at least 50% (by volume) of water.

Given a well-planned flow-distribution system there should be no risk of settlement and choking. One working difficulty may arise if the mill which discharges its tailings continuously must deliver them periodically. Surge storage in large conical-bottomed tanks with agitation by sturdy propellers is one answer, while surface dumping and repulping is another. To facilitate the movement of pulp through pumps and piping the last stage of desliming is deferred until the material is at the surface delivery point. Cyclones are widely used at this stage, the overflow being sent to slimes dams. The laboratory tests which are made before deciding as to the suitability of a tailing include sizing analysis, classification tests, check on risks arising from oxidizable minerals, and residual moisture after optimum drainage times. The material should also be checked to ensure that no potentially valuable secondary minerals are being permanently lost in the backfill.

(10) *Magnetic Separation*

Mesabi Range Taconites

Wet separation is used exclusively for magnetic treatment at Mesabi, though dry methods are being developed on the pilot scale. The general flow-sheet (Fig. 1) starts with staged wet grinding and rejection of a non-magnetic tailing at each stage. Three-stage grinding either with open or closed circuit roughing is alternatively used. "Magnetic" desliming is also applied in all circuits but this is not shown in the flow-sheet. In the "cobbing" stage about 40% of the head feed is rejected and a further 12% to 15% is removed at the roughing stage of magnetic separation. It is easier to attain high recovery than a high efficient rejection. In wet-drum work the magnetic material flocculates on entering the field of flux and little rejection of its entrained gangue is thereafter possible. The smaller the particle the lower must be magnetic intensity, feed rate, and solid/liquid ratio. At least two stages of cobbing separation are used. One stage only is used in the closed-circuit roughers but these carry a high circulating load so that in effect at least three separations are made here. Drum speeds vary from 150 to 250 ft./minute. The higher the speed the wetter and consequently dirtier is the concentrate. Tank design is governed largely

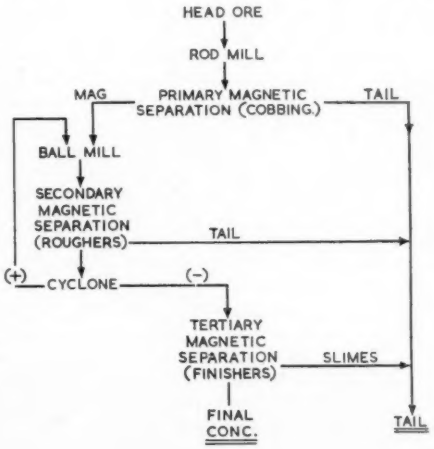

Fig. 1.

by particle size. This is preferably with overflow discharge, but for 20-mesh feed a spigot discharge is necessary.

Pulp must be turbulent when entering the magnetic field. In Scandinavia drums of 24 in. are standard but U.S. practice uses 30 in. or 36 in., while drums are at least 6 ft. long. Permanent magnets are often practicable where constant field strength is possible. Stainless steel is favoured for shell and tank construction and drums run on sleeve-type bearings. For desliming the classifier overflow is flocculated by passing through magnetizing coils. It then settles while gangue slimes overflow. The settled material is removed as the thickest possible slurry to minimize gangue entrainment. Control testing is done largely in Davis magnetic tubes.[1]

(11) *Screening*

Reduction of Blinding

Writing in the *Engineering and Mining Journal* for December, 1958, J. E. Fink gives a few hints on the elimination of screen blinding. It is generally due to one of three causes—improper operating characteristics of the vibrating screen, moisture in the material of the finer meshes, and irregular particle shape of the material. The important operating characteristics of the screen itself are frequency, amplitude of motion, direction of rotation, and slope. Speed varies from over 1,000 vibrations a minute for fine material up to $\frac{1}{8}$ in. down to 650 vibrations for material up to 10 in. The flow in the first case would be between $\frac{1}{16}$ in. and $\frac{1}{4}$ in. and in the last up to $\frac{1}{2}$ in.

Blinding which is due to moisture causes the fines to cling not only to the wires of the screen but also to other material and a change from square to rectangular mesh may improve this. Occasional blinding can be dealt with by brushing the cloth or hitting it to dislodge the damp material. Rubber balls can be put in in such a way that they bounce against the underside of the screen surface and set up a secondary dislodging vibration. Heating of the screen surface by electrical methods or the use of gas has achieved success in a number of cases; low-voltage current is used from single-phase transformers. When gas burners are used they are set below the screen to throw a long flame parallel or at a slight angle.

[1] Forcia *et al.* "Magnetic Separation for Mesabi Magnetite Taconite." *Min. Engg.*, Dec., 1958.

(12) *Roasting*

Treatment of Japanese Pyrite

About a quarter of Japan's pyrite comes from the Yanahara mine, on Honchu Island, and until recently this pyrite could only be sold for its contained sulphur, which left some 7,000,000 tons of high-grade iron ore as waste. The situation has been considerably improved by the introduction of the "Fluo-Solids" roasting system which now gives a market for the mine's pyrrhotite. Before this there was no practical method for commercial exploitation of this mineral and in addition larger deposits of pyrite were unacceptable to the iron and steel industry because of their copper content. The chloridizing roast method used in Europe in these circumstances could not be applied because salt must be imported which renders the process uneconomic. Most of Japan's sulphuric acid comes from the roasting of local sulphides and most of the iron ore is imported. The pyrite has hitherto had to contain about 50% of sulphur and this required selective mining and a considerable loss of mineral owing to the irregular

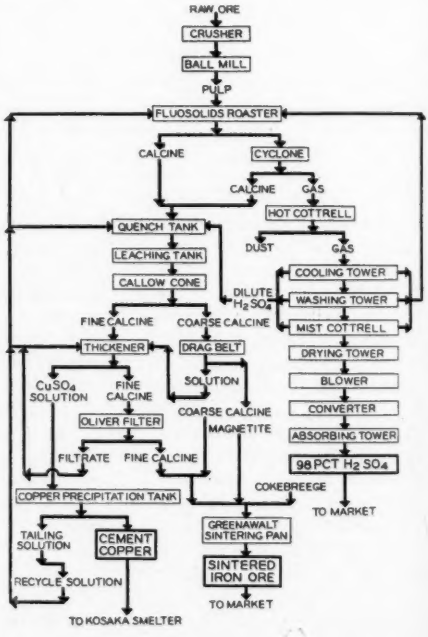

Fig. 2.

boundaries of the deposit, while there was no market for pyrrhotite because of the freight charge per unit when sulphur was the only end value.

The research problem was to produce selective sulphitization of the copper while producing concentrated sulphurous acid gas suitable for conversion into sulphuric acid. If this could be done the roasted calcine could be leached for its copper and the leach residue sintered to yield lump iron ore which would have to carry less than 0·2% of copper for commercial use. Test work established that this could be done if a Fluo-Solids system was operated at between 625° C. and 650° C. with 7% to 8% SO_2 in the exit gas.

Pyrrhotite at *minus* 1 in. is ground and fed at 70% to 75% slurry to surge storage and thence to a 20-ft. reactor. Reaction is exothermic and controlled by the use of 85 lb. of water to 100 lb. of ore; 40% of this water comes with the feed slurry and the balance is added automatically by means of a temperature controller. (A flow-sheet of the process is given in Fig. 2.) Overflow and cyclone products are collected to quench tanks in which most of the leaching takes place, the quenching solution being made up from recycled acid from the copper precipitation tanks together with dilute acid from the gas washing tower. Washing efficiency is 95% for the classifier circuit and 95% for the thickener filter circuit. Pregnant copper solution carries 2·5 g. per litre of copper, 20 g. per litre of iron, and 5 g. per litre of free sulphuric acid. The copper is precipitated on scrap iron, the process being aided by air agitation. Effluent solution carries 0·3 g. per litre of copper, 23 g. per litre of iron, and 4 g. per litre of free sulphuric acid. A contact system produces 98% acid from the exhaust gas leaving the roaster cyclone.

The first section of this plant started in September, 1953, with a rated capacity of 115 tons per day; in July, 1956, a second reactor of similar capacity went to work. Present approximate average copper analyses of feed, calcine, and leach residue are respectively 0·8%, 1%, and 0·14%. Copper solubility is 85% with the recovery of 82%, and the overall iron recovery is 99%. The whole treatment has been profitable in several ways.[1]

[1] KURUSHIMA, H., and FOLEY, R. H. "Fluo-Solids Roasting of Dowa's Yanahara Sulphides." *Min. Engg.*, Oct., 1958.

Book Reviews

New Observations on the Ores of the Witwatersrand in South Africa and their Genetic Significance. By PAUL RAMDOHR. Paper covers, 50 pages, with 61 plates. Annexure to Vol. LXI (1958) of the *Transactions and Proceedings* of the Geological Society of South Africa.

One of the more weighty contributions to the controversy on the gold-uranium mineralization of the Witwatersrand is the lengthy monograph by Professor Paul Ramdohr (1) [1] of Heidelberg, published by the Deutschen Akademie der Wissenschaften zu Berlin in 1955, in which a report is given of a detailed mineragraphic study of the ores. A balanced understanding of the issues between syngeneticists and epigeneticists is scarcely possible without a close reading of Ramdohr's work; but although the MAGAZINE did much to promote a wider knowledge of his investigations by the publication in 1955 of a long well-illustrated review by Dr. Sommerlatte (2), the German language of the original memoir has to some extent limited its circulation among English and American geologists. To facilitate wider reading the Council of the Geological Society of South Africa invited the author to prepare an English translation; and this has now been issued, complete with 61 plates embodying 130 photomicrographs as an annexure to the *Transactions* of the Society (3). That this costly republication in support of the placer hypothesis should have been considered necessary is a measure of the interest taken in the current disputations and a tribute to the force of the opposing, hydrothermalist, arguments. It is paralleled by a recent reprinting of Dr. Liebenberg's contemporary mineragraphic studies (4), with 150 photomicrographs, the conclusions of which are complementary to Ramdohr's observations.

The present notice of Ramdohr's work is not at all a critical one since the German text has already been criticized by the reviewer elsewhere (5). Its primary object is to assure the English reader of the excellence of the translation, which in no material particular diverges from an earlier translation prepared in London under official auspices. The author is to be complimented on the facility with which he has preserved so many of the nuances of the German

[1] Figures in parentheses refer to the references given at the end of this review.

phraseology and on the rigorousness with which he has eschewed the introduction of second thoughts. Of the minor amendments a few have been made in the interests of international amity.

Throughout the translation the author retains the German name *Uranpecherz* for the uranium mineral in the ores, in the belief that the use of one or other of the terms uraninite or pitchblende would be contentious; but nevertheless he concludes from the thorium content of this mineral that "it must be accepted that the *Uranpecherz* may be pegmatitic and certainly is of high-temperature origin." Had he but recognized that UO_2 is isomorphous not only with ThO_2 but also with CeO_2, and that the rare-earth content of the Rand mineral is comparable to that of auriferous hydrothermal lode pitchblendes, the mesothermal character of the mineralization would have been more obvious to him. Equally open to misapprehension is the constant and consistent reference to "pebbles" of *Uranpecherz* (and pyrite) in translation of the German term *Gerölle*. The so-called pebbles have an average diameter of 70 microns; and as German critics (6) have emphasized, any interpretation of the *Uranpecherz* as alluvial detritus must account for the fact that these rounded particles are not "pebbles" (*Gerölle*) at all, but are a fine dust (*feinster Staub*). Like Humpty Dumpty, Ramdohr may if he wishes use a word to mean just what he chooses it to mean—but in the currency of international understanding a silt-grade particle is no more a pebble than a pfennig is a Deutschmark.

A new work by the same author on the geology of the Witwatersrand and Blind River bankets has just been announced (7) and further discussion had perhaps better await its publication.

C. F. D.

(1) RAMDOHR, P. "Neue Beobachtungen an Erzen des Witwatersrands in Sudafrika und ihre genetische Bedeutung." Akademie Verlag, Berlin, 1955.

(2) SOMMERLATTE, H. W. A. "Mineralogical observations on Witwatersrand ores." THE MINING MAGAZINE, **93**, 142–152, 1955. 20 figs.

(3) RAMDOHR, P. "New observations on the ores of the Witwatersrand in South Africa and their genetic significance." *Trans. Geol. Soc. S. Africa*, Annexure to vol. **61**, 50 pp. + 61 pl. 1959.

(4) LIEBENBERG, W. R. "The occurrence and origin of gold and radioactive minerals in the Witwatersrand System. . . ." *Trans. Geol. Soc. S. Africa*, vol. **68**, pp. 101–254, pl. 15–38, 1956. Reprinted in "Uranium in South Africa," vol. **1**, Johannesburg, 1957.

(5) DAVIDSON, C. F. "On the occurrence of uranium in ancient conglomerates." *Econ. Geol.*, vol. **52**, pp. 668–693, 1957.

(6) LANGE, E. "Zur Genese der Witwatersrand Erze." *Zeits. F. angew. Geol.*, vol. **8**, pp. 238–241, 1958.

(7) RAMDOHR, P. "Witwatersrand, Blind River, Dominion Reef, Serra de Jacobina." *Abhandl. Akad. Wiss. Berlin*, 1959 for 1958. See also RAMDOHR, "Uran in alten Konglomeraten," *Geologie*, vol. **7**, pp. 965–8, 1958.

The Science of High Explosives. By MELVIN A. COOK. Cloth, large octavo, 440 pages, illustrated. Price 180s. New York: Reinhold Publishing Corporation. London: Chapman and Hall, Ltd.

This book, No. 139 in the Monograph Series designed by the American Chemical Society, is an exposition of the physical chemistry of detonating explosives. The author, who is Professor of Metallurgy and Director of the Explosives Research Group in the University of Utah, refers in the preface to his own 20 years of research in high explosives and explains that he has not hesitated to draw "heavily on the results of studies by himself and his associates." Following an account of the explosives industry and the technique of testing, the book covers the fundamentals of the processes of detonation in detail, going on to examine the behaviour of solids under explosive attack. The principles of shaped charges are then reviewed and then the blasting action of high explosives and explosion properties.

The last three chapters in this excellent monograph deal, in turn, with the products of detonation, shock waves, and the damage potential of air and ground blast waves. There follow three appendices, the first a glossary, the second covering calculations of products of detonation, and the third on "Bands in Solids and Their Influence on Thermal Expansion and Compressibility." An author index and a subject-index complete the work.

Kempe's Engineers Year Book, 1959. In two volumes in case (3,000 pages), illustrated. Price 82s. 6d., plus 2s. 6d. postage. London: Morgan Brothers (Publishers), Ltd.

In this, the 64th edition of what has become a standard reference library for engineers, all 79 chapters have, as usual, been thoroughly revised and two of them have been completely rewritten. Aided by a comprehensive index and the bibliographies

following individual chapters the reader will find this new Kempe its own reliable self.

☛ Copies of the books, etc., mentioned under the heading " Book Reviews " can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Engineering Log

In a statement issued in San Francisco, A. L. Smith, of the U.S. Naval Radiological Defense Laboratory, described the ever-growing problem of the safe disposal of radioactive waste. Present practice is in accordance with standards authorized by the Atomic Energy Commission and the National Bureau of Standards. Problems arise largely because of the many forms in which the material accumulates. Most complicated are the liquid forms, or water solution wastes, which vary in radioactivity between high, medium, and low levels of radioactive content. The present storage of high-level wastes in tanks creates a problem which increases as time goes on. No safe method of ultimate disposal of this material has yet been found. Volume of tankage now in use or planned presently reaches a figure of some 100,000,000 gallons. Not only is a progressive increase of the volume of tankage required an expensive prospect, unless some method of safe disposal can be found, but tanks already in use have a safe life which is measurable in decades, whereas the duration of toxicity of the materials which the tanks enclose can be measured in centuries. Medium-level waste is handled in various ways, according to the conditions at the site where it is produced. If the soil is suitable it may be discharged into the earth, although it is necessary to make sample checks by means of test wells surrounding the burial area to determine whether any migration is occurring. In populated areas, however, it is necessary to concentrate these materials as high-level waste. At major sites operated by the Atomic Energy Commission solid waste is buried in trenches. This is the procedure at five installations which operate permanent burial grounds. One of these also accepts solid waste material for disposal from other installations. Some of the installations dump waste at sea. For this procedure both solids and liquids have to be packaged and sunk in an ocean region to a minimum depth of 1,000 fathoms. At this point they are relatively inaccessible, at least for the time being.[1]

[1] *Industrial Laboratories*, Feb., 1958.

It was recently reported that the erection of a £396,000 walking dragline is now in progress at the Yarborough ironstone quarry, Scunthorpe, of the Ore Mining Branch of the United Steel Companies, Ltd. This 790-ton machine, the W600, is expected to begin work in June stripping overburden. It has a 186-ft. long jib and a 10-cu. yd. bucket which will enable it to strip 15 tons at each " bite," the iron ore uncovered to be removed later by smaller mechanical diggers. Initially the depth of overburden will be 30 ft., increasing as the quarry is exploited. This W600 is the second machine of its kind in the Scunthorpe area, the previous one having been in operation at Crosby Warren for the past two years. Both these quarries supply the adjacent works of Appleby-Frodingham Steel Company with iron ore and when the new dragline starts work the Yarborough quarry will be able to provide between 36,000 tons to 40,000 tons of ore per week for that company's blast furnaces.

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The higher animals, it has been determined, respond to environmental stimuli by translating them into electrochemical signals which are carried by the nerves to the brain. A number of electronic instruments have been devised which perform functions similar to those of the sensory organs; they convert such things as a change of atmospheric pressure into an electric signal. Now nerve specialists are seeking ways in which this similarity of function can be used to help human beings whose sensory organs have been damaged or destroyed. At the Faculty of Medicine in Paris a number of successful experiments have been made with animals and an electronic ear has been used to help one man who was completely deaf. Up to the present time it has been possible to excite nerves by means of electric impulses only when the current was directly applied to the exposed nerve during an operation. Metal wires have been attached to a nerve through a wound but after the wound had healed the area either became infected or the tissues rejected the foreign body. In Paris, André Djourno, Professor of Electrophysiology, has found a method of overcoming this problem by the use of a small induction coil left in the tissues and connected to the nerve. Since living tissues are transparent to a magnetic field currents can be induced in this embedded coil by means of another coil outside the body.

After a testing period the results obtained were applied to a human patient. Although the man had been totally deaf and the auditory nerve in disuse for some time and in spite of the fact that the nerve was badly damaged as a result of a previous operation he was enabled to hear sounds again by means of the coil embedded in a plastic sheath in the temporal muscle. However, the induced current now being carried to the auditory nerve from the secondary, embedded, coil was in a different "code" from the one received by a normal ear. It was necessary for the patient to learn to interpret the new signals and he is making progress with this process of re-education. His achievements should be of great assistance in future attempts. He has an apparatus whereby he can talk to himself and learn to recognize the sounds he pronounces. Whereas a normal ear will respond only to sound frequencies of up to 15,000 vibrations per second it has been established that he is sensitive to frequencies of up to 40,000. A continuous sound is less easily distinguishable than an intermittent one for him. Many patients, especially young ones, suffer total deafness as the price of a life saved by streptomycin treatment and the electronic ear should be invaluable for them. The procedure may well prove capable of extension so that other sensory organs may be replaced. It may be used, too, in endocrinology to activate dormant glands and in polio cases may replace the iron lung by inducing movements of the diaphragm through stimulation of the phrenic nerve and so enabling the patient to breathe.[1]

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Turkey's mineral industry—slowly growing despite such obstacles as expensive transport and lack of adequate geological information—is the subject treated in an Information Circular of the United States Bureau of Mines. According to the report, Turkey's chief mineral product is chromite, of which it has supplied as much as one-fifth of the world's total output in recent years. When Russia stopped exporting metallurgical-grade chromite to the United States in 1947 Turkey greatly increased its output and now is a major source of supply. Although it also exports small surpluses of a few other minerals and is self-sufficient in coal Turkey now imports nearly all its petroleum at an annual cost of more than $40,000,000. This dependence on oil imports may lessen, the report notes, if private exploration now underway reveals new petroleum deposits. In addition, production of other minerals may increase, since large areas of the country that have not yet been fully mapped are considered favourable for exploration. Recent prospecting has uncovered new deposits of tungsten, molybdenum, and boron minerals.[1]

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An outstanding achievement in the North of Scotland Hydro-Electric Board's programme has recently been confirmed with the announcement that the driving of the network of tunnels in the Killin (Perthshire) section of the Breadalbane Scheme has been completed. Work began on this section on April 1, 1957, and the driving of the tunnels has been finished nine months ahead of the Board's schedule. The project involved the main contractors, the Mitchell Construction Co., Ltd., in the building of 18 miles of access roads, 14½ miles of tunnels, and 7 miles of pipe aqueducts up to 6 ft. diameter. The work is split over an area of about 50 sq. miles and required survey work over mountains more than 3,000 ft. high. By using a helicopter the contractors speeded up the surveying sufficiently to allow tunnelling to start on June 1, 1957. Since then over 3,500,000 ft. of blast-holes have been drilled and over 1,000,000 lb. of explosives used in excavating the 14½ miles of tunnels. The high speed of tunnel driving which the construction company has attained on this work is over three-quarters of a mile per month and equal to their achievement on the St. Fillans Section of this scheme, where they set up a record 557 ft. of tunnel driven in one week on one heading.

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The task of digging trench walls in immediate proximity to tall buildings is normally a treacherous one. An Italian contractor, however, has worked out a method which, while inexpensive in itself, eliminates all costly bracing. The contractor digs a trench to the required wall depth, fills it with bentonite mud, puts in the steel reinforcement, and then fills the trench with concrete. The bentonite is of a gelatin-like consistency and serves to brace the walls of the trench in the early stages and hold them until the

[1] *Science Digest*, Nov., 1958.

[1] NAHAI, L. *Inform. Circ. U.S. Bur. Min.*, 7855.

concrete is ready to be poured. The pouring of the concrete forces the bentonite to the surface, where it can be reclaimed. This method was devised for the construction of part of Milan's Metropolitana Subway. The tunnel under construction is half open-cut and runs a distance of 1½ miles. Width of the tunnel is 25 ft. and the arch is placed 10 ft. below street level; the concrete bulkheads are sunk 27 ft. down. The bentonite process is used only where the tunnel passes near tall buildings and shallow trenches therefore became necessary, not for open-cut excavations where no buildings were there to raise a problem. The first step in the bentonite process is the cutting of an open excavation to the full width of the tunnel and to a depth of 10 ft. along the right of way of the tunnel. For the tunnel walls parallel trenches are dug 27 ft. deep and 3 ft. wide. A rail-mounted rig operates a clamshell bucket. A hopper attached to the rig carries materials to a conveyor which deposits them in a rail-riding muck car. The walls are stabilized with bentonite mud pumped into the trench, reinforcing steel cages are lowered into the mud, and a second crane-like rig handles the tremie concreting riding the tracks. Total costs of building Milan's subway, for which the operation described is being carried out under special contract, is estimated at $5,000,000 by the time of its completion some time in 1960.[1]

News Letters

VANCOUVER

February 9.

Prospecting.—A staking rush of considerable proportions is now taking place in northern British Columbia. The sudden interest has been aroused by the release by the Geological Survey of Canada of Information Circular No. 3, describing field work in 1958 and particularly directing attention to asbestos deposition 70 miles almost due north of Telegraph Creek and molybdenite deposition 40 miles directly west of the same village on the Stikine River. Despite deep snow staking is being carried on by at least seven major exploration companies and by individual prospectors. The Phelps Dodge Corporation of Canada, Ltd., Cassiar Asbestos, and Northwestern Explorations (the Canadian exploration arm of the Kennecott Copper Corporation) are understood to have been first on the ground and to have acquired key claims. The report describes important concentrations of long-fibre chrysotile asbestos in one area and " abundant molybdenite in a pink monzonite stock " in the other.

Laird.—The Cassiar Asbestos Corporation has reported very successful operation during the year ended September 30, 1958. A net operating profit of $2,897,050 was realized after all operating cost and generous provision for write-offs. The mill treated 389,232 tons of ore for an average of 1,065 tons per calendar day. At the end of the fiscal year, with the mining season for the year completed, there were 92,415 tons of dry ore in the dry-rock storage building and 152,222 tons of ore in the stockpile—sufficient to supply the mill at capacity until June, 1959. Ore reserves have been estimated at 8,000,000 tons in the first stage of open-pit mining, extending to a depth of 120 ft. below the 6,000-ft. elevation, and a high quality of fibre was consistently recovered throughout the year.

The corporation was again spectacularly successful in its outside exploration programme, conducted at a cost of $293,207, including property payments. On the Clinton Creek group of claims, 40 miles north-west of Dawson, an aggregate of 5,300 ft. of drives and cross-cuts was driven under surface exposures. An extensive sampling programme involved shipment of five bulk samples to a total of 423 tons to Cassiar for milling on a production scale to determine fibre content and maximum recovery. The results of this work, carried out under the direction of the company's general superintendent, proved encouraging beyond anticipation and formed the basis of an estimate of 5,000,000 tons of high-grade asbestos ore to a depth of 50 ft. below the adit level, with a waste to ore ratio of 2 to 1. A report from an independent consultant has confirmed the superintendent's conclusions.

Vancouver.—The Britannia Division of the Howe Sound Company expects to re-open the Britannia mine and mill before the end of February. Some 200 men are now employed in the rehabilitation of the property and plant. There will be no aspect of " company " town or camp to the revived operation, the company having leased all residences, bunkhouses, mess-houses, and the general store to individuals who are, in turn, renting the premises to mine and mill employees.

[1] *Construction Methods*, Sept., 1958.

Situated within 30 miles of and connected by paved highway with Vancouver the mining operation will be conducted along the lines of a suburban manufacturing plant.

Lillooet.—Shareholders of Bralorne Mines and of Pioneer Gold Mines of B.C. are to vote on February 16 and February 25 respectively on the proposal to merge the two companies through the outright purchase of all Pioneer assets in return for the issue of 350,350 Bralorne shares to replace the outstanding 1,751,750 shares of Pioneer. The combined treasuries will contain $3,000,000 in working capital with only 1,597,350 shares of Bralorne issued. In the quarter ending December 31, 1958, Bralorne produced 28,113 oz. of gold from 37,587 tons of ore, assaying 0·748 oz. gold per ton, to bring the calendar year's production to 99,475 oz. from 146,358 tons, averaging 0·671 oz. per ton. The quantitative production is close to that of the best years of the mine and with the decidedly higher grade of ore now being drawn from the deep Queen shaft section the management is confident of very profitable recovery in 1959. At November 30 last independent consulting engineers estimated the ore reserves in the Bralorne mine at 732,000 tons, grading 0·70 oz. of gold per ton, and in the Pioneer mine 139,280 tons, averaging 0·48 oz. per ton.

Further news of note from the Bridge River district is the announcement that Canadian Aerial Exploration, Ltd., has acquired an option to gain a 60% interest in the Little Gem mine through an agreement with Northern Gem Mining Co., Ltd. Canadian Aerial Exploration is a wholly-owned subsidiary of Canadian Exploration, Ltd., which in turn is a wholly-owned subsidiary of Placer Development, Ltd. Under the terms the optionee will have the coming summer to effect preliminary investigation and by September must elect to proceed to production or forfeit its option. All expenditures of Northern Gem, estimated at $200,000, as well as all pre-production expenditure of Canadian Aerial Exploration, are returnable out of first production. Messrs. J. R. and R. R. Taylor, who assigned the property to Northern Gem, have assisted the negotiation by agreeing to a cut from a straight 15% of net smelter returns to 15% of net smelter returns to a gross amount of $125,000; thereafter, 5%. Work will commence in June, when snow leaves the workings at 6,000 ft. elevation.

New Companies.—Deep Gulch Mines, Ltd., has been organized to develop a 30-claim copper prospect 15 miles south of Princeton, on the Hope-Princeton highway. Mineralization has been exposed for a length of 1,920 ft. and a width of 600 ft. in a zone believed to form a part of the Copper Mountain stock. The property lies directly across the Similkameen River and only 2 miles from the Copper Mountain mine, which was closed in 1957 after some 40 years of intermittent operation.

Consolidated Woodgreen Mines, Ltd., has been organized to acquire the assets of Woodgreen Copper Mines, Ltd. Shareholders of the latter are to receive one share of Consolidated Woodgreen for each eight shares of Woodgreen now held. The new company is rehabilitating the open-pit workings and the 1,000-ton mill and proposes new production in the immediate future. The Woodgreen mine operated for a few months in 1957, but was forced to suspend production due to declining metal prices and the unusually heavy overhead.

Canadian Western Gypsum Corporation, Ltd., has been incorporated to develop a group of 25 mineral claims in the Canal Flats section of south-eastern British Columbia. The company's engineers have estimated a deposit containing 100,000,000 tons of gypsum-bearing material with a value of more than $6 per ton.

Golden.—Giant Mascot Mines, Ltd., has reported an operating loss of $34,338 in the year ended September 30, 1958. The estimated returns from barite production were $15,000 and other income amounted to $7,458. Barite production was halted abruptly when fire destroyed the drying and bagging plant erected on the property by the purchasers of the product at a cost of $85,000. The plant is to be rebuilt as soon as insurance is adjusted and weather permits the work. Although the tailing pond, resulting from Giant Mascot's nine-year lead-zinc mining operation, is estimated to have 700,000 tons of material containing 49% barite the company's consulting engineer informed the annual meeting that providing the barite market is sustained it is planned to re-open the mine to extract a large block of rich barite ore containing also 0·5% lead and 3·0% zinc.

Nighthawk Gold Mines, a controlled subsidiary of Giant Mascot, is preparing to equip the Good Hope gold mine at Hedley for early gold production and has effected an agreement with French Mines, Ltd., for the use of spare milling capacity. Nighthawk is also active in Yukon and is considering the acquisition of further placer ground within reach of the company's two big bucketline

dredges on the Sixtymile River, south of Dawson. During the past year Nighthawk has repaid Giant Mascot some $35,000 of a $55,000 advance made at the time the former company purchased all the assets of Yukon Gold Placers, Ltd.

Merritt.—Torwest Resources has effected an agreement with Eila Investments, Ltd., for the financing of the development of the promising Swakum Mountain copper prospect near Merritt. Eila Investments has advanced $100,000 of a commitment for $250,000 and holds options which will provide ample funds to carry the development to the production stage if indicated ore is proved. In addition to the geophysical surveys two diamond drills are currently in operation.

Yukon.—A notable increase of 30% in silver production has been reported by United Keno Hill Mines for the three months ended December 31 last, the first quarter of the current financial year, when recovery was 1,954,100 oz. of silver, 6,018,400 lb. of lead, and 4,919,100 lb. of zinc. This compares with 1,492,000 oz. silver, 5,421,500 lb. lead, and 4,730,800 lb. zinc in the first quarter of the previous year. The company's annual report for the year ended September 30, 1958, issued almost simultaneously with the quarterly report, shows a net profit of $586,840, equivalent to 23·7 cents per share, as compared with $1,001,748, or 40·5 cents per share in the previous year. Almost 10% more ore was treated in the later year but heads were slightly lower. Production was 6,984,373 oz. of silver, 22,255,501 lb. of lead, 18,610,970 lb. of zinc, and 229,308 lb. of cadmium from 175,058 tons assaying 36·83 oz. silver per ton with 7·18% lead and 6·10% zinc. At September 30 last the ore reserves were estimated at 587,940 tons, grading 36·65 oz. of silver per ton, with 6·59% lead and 5·53% zinc. During the last fiscal year United Keno Hill purchased the adjoining property of Canadian Northwest Mines and Oils, Ltd., formerly known as the Makeno and later the Balkeno mine, including the mill and certain additional claims held by an associated company. The purchase price was $300,000, of which $231,825 has been charged to value of equipment acquired.

Silver Standard Mines, Ltd., has staked 16 additional claims to bring its block of ground adjoining the Brown-McDade mine, near Carmacks, to 48 claims. The company has allocated $40,000 for geophysical survey and surface work during 1959.

TORONTO

February 25.

Gold Production.—The output of the gold mines of Ontario for December included 227,656 oz. of gold and 41,277 oz. of silver, valued at $7,700,672, from 787,573 tons of ore milled. During 1958 the Province's 30 producing gold mines reported milling 9,309,849 tons of ore which contained 2,652,370 oz. of gold and 433,537 oz. of silver with a total value of $90,432,750. In the previous year 30 mines milled 8,977,583 tons ore containing 2,527,806 oz. of gold and 422,106 oz. of silver, worth $85,293,143.

Blind River.—The shafts at the Nordic and Quirke mines of Algom Uranium are being deepened during the winter. At Nordic the shaft is to be taken down to 1,325 ft. and that at Quirke to 1,164 ft. New levels are to be opened up in both mines.

Manitoba.—It is reported that important copper-nickel mineralization has been discovered on the Tow Lake property of Genrico Nickel Mines, which lies about 30 miles east of Lynn Lake. Samples over a length of 4 miles have been assayed and show up to 0·66% nickel with 3·2% copper.

Work on the Agassiz property 3 miles north of Lynn Lake is to be resumed by Central Manitoba Mines. A contract for an additional 3,000 ft. of drilling has been let, results obtained in the drilling during November last having proved favourable.

Panther International Mining is planning a 10,000-ft. drilling programme on its claims in the Mystery–Moak Lake nickel area, where 16 anomalies are to be drilled. Airborne and surface geophysical surveys have already been made.

Quebec.—It has been announced that work is to be resumed by Chibougamau Jaculet Mines which closed down in December, 1957. Underground mining in the No. 2 zone is to go ahead while a rise is put up from the 300-ft. level to the surface. This is being done in co-operation with Copper Rand Chibougamau Mines, which is to finance operations and treat the ore on a cost *plus* 15% basis.

MELBOURNE

February 20.

Mount Isa.—The production of Mount Isa Mines is growing rapidly as a result of the progress of the expansion programme and it is

probable that in the 1958–59 financial year the output of combined lead-zinc and copper ore will approximate 2,000,000 tons. In the first seven 28-day periods of that year a total of 1,138,498 tons of ore was treated, as compared with 810,104 tons in the previous corresponding period; in the 1957–58 year the total production of ore was 1,655,070 tons. Ore treatment is now at the rate of 6,750 tons per day, as compared with 4,510 tons per day in February, 1958. It is expected that throughput will be at the rate of 8,100 tons per day by April.

Commencement of operations by the electrolytic copper refinery at Townsville is expected by the middle of this year. Construction of the new power house at the mines is progressing and large consignments of plant and equipment are on the way from the coast to Mount Isa. It has been announced that the Queensland Government has made available a sum of £A1,250,000 for the rehabilitation of the Townsville–Mount Isa railway, on which the company's expansion to the planned scale depends. The delay in commencing this work has been a cause of anxiety.

Broken Hill South.—In contrast with the Mount Isa expansion Broken Hill South has reduced its output of ore, which in the six months to December 31 fell sharply. The tonnage treated was 166,760 tons, as compared with 185,670 tons in the corresponding period of 1958. The output of lead concentrates decreased from 28,281 tons to 27,191 tons and that of zinc concentrates from 36,371 tons to 35,329 tons in the same periods. Assay values of the crude ore treated increased from 11·8% lead to 12·5%; from 7·0 oz. to 7·4 oz. for silver, and from 11·4% to 12·2% for zinc.

The South mine has maintained remarkable persistence in its ore reserves over a number of years since the effect of the pitch of the ore-bodies to the south became more and more apparent; this was compensated in extraction figures by the acquisition of the old Broken Hill Proprietary, Central, and Block 10 leases, but mining conditions are here becoming increasingly difficult as the readily-accessible blocks of ore are being worked out. The high standard of metallurgical work has been consistently maintained.

Tennant Creek.—The Australian Development Company has now paid £A3,526,259 in dividends from its Noble's Nob mine since mining was commenced in 1947. While there has been little extension of ore in depth below the 315-ft. horizon there has been very consistent lateral extension above that horizon and ore extraction at the rate of over 30,000 tons per year has been more than compensated by the development of new ore. At the present time the ore reserves are equivalent to about six years' life. High values in driving and cross-cutting have been reported at the 165-ft. level of the No. 5 shaft. Values in 10 ft. of cross-cutting were 26·3 dwt., which closely approximate the grade of ore exposed in other workings.

Peko mines, the only copper producer in the Northern Territory, gives latest returns, which show a decrease in copper production but an increased gold content in the concentrates. In the last period production was 8,918 tons of ore for the recovery of 1,765 tons of concentrates, with a grade of 26·25% copper and 8·37 dwt. of gold per ton. The concentrate is transported by combined road, rail, and sea to the smelters at Port Kembla, New South Wales, involving a high transport cost. The mine has been opened up to a depth of 1,000 ft. and has ore reserves approximating 1,000,000 tons of a grade between 6% and 7% copper. Investigations into smelting at the mine do not appear to have been satisfactory, so that high transport costs must still be faced. The company has recently drilled the Orlando lease, about 8 miles to the west. A series of drill holes in the vicinity of a geophysical anomaly made several intersections of ore assaying from 20 dwt. to 80 dwt. of gold per ton, with one intersection also giving 9% copper. The total length of proving was 1,200 ft. and the intersections were at or above the 400-ft. horizon. As gold-shoots in all but two of the many mines prospected have ended at 100 ft. to 150 ft. these results are very interesting, as indicating either the bottom of the known gold-bearing horizon or the top of a new auriferous zone. The company will sink to the 400-ft. or 500-ft. horizon and drive on the lode to assess the value of the discovery and to what extent equipment of the mine may be warranted.

Bauxite.—The Commonwealth Aluminium Corporation has been granted a special mineral lease of 22 sq. miles in the Gove Peninsula, Northern Territory, which is known to contain substantial bauxite deposits. Testing is necessary before the commercial value of the deposits can be known. Conditions of the grant are that a thorough examination must be made within

two years and plans for development of the ore-bodies and the treatment of the ore submitted to the Commonwealth Government within five years.

It is possible that the supply of bauxite and alumina to the Bell Bay works of the Australian Aluminium Commission may be a condition of the lease. Expansion of throughput at Bell Bay is considered essential to the economics of the proposition, which is owned jointly by the Commonwealth Government and the Tasmanian State Government. The introduction of the necessary capital from private enterprise has been under consideration and an examination has been made of the works and the enterprise generally by British interests. Result of this investigation is not yet known, but it has been reported that a satisfactory arrangement would mean doubling the capacity of the works, which is now 11,000 tons of aluminium ingots per year.

Western Australian Gold. — The State Department of Mines has reported the production of gold during the month of December, 1958, as 120,106·04 fine oz., bringing the total production of the State to 59,912,902 oz. The production for 1958 was 867,187 fine oz., against 896,681 oz. in 1957. The position of the industry in the State is well maintained and the mines would be in a position to take quick advantage of a satisfactory increase in the world price. There is an improving interest in gold production and prospecting by smaller interests which would expand quickly with a price incentive. Two Kalgoorlie mines—Lake View and Star and Great Boulder Gold Mines—are carrying out large electrification schemes which will result in lower costs. Lake View and Star is spending £A300,000 in provision of an electric winder and new steel headframe 113 ft. high at Chaffers shaft and in additional power units. This work will be completed by the end of the current year. In the past three years Lake View has electrified the Ivanhoe, Lake View, and Associated shafts at a cost of £A160,000.

Great Boulder Gold Mines is also engaged in a shaft electrification programme costing £A250,000. In previous years winders were steam driven and were the last units to be modernized in the electrification schemes, which have been so important in keeping Kalgoorlie costs within profitable limits and maintaining the stability of the industry.

Coal.—The revival in the New South Wales black-coal industry is likely to grow. The export trade has now been built up to the vicinity of 1,000,000 tons per year and recent statements indicate that Japan is willing to import over 3,000,000 tons of Australian coking coal in the next five years. A new contract has been entered into with one colliery for 1,178,000 tons of coal. The import price for the first year will be £A4 7s. 6d. per ton f.o.b. for washed coal of 10% ash content. The industry has made great progress in mechanization and increased efficiency. Output per man shift has been raised from about 2·9 tons to over 4 tons per total employee. Costs have been reduced to a competitive level and not only the overseas sales but also the domestic sales and demand position have improved substantially. This position has, naturally, been accompanied by the closing down of uneconomic mines, hand labour, and marginal collieries, with consequent dismissal of employees.

The improvement in the industry has been helped by greater industrial peace but strikes on one well-mechanized colliery, resulting in the loss of 90,000 tons of coal in the period, have forced the mine to close down. As regards the future the State Government is pressing on with the erection of coal-burning electric-power stations, situated on the coalfields, which will substantially increase the consumption of black coal and bring about the re-employment of dismissed miners.

Oil.—The Commonwealth Government policy on oil exploration is to meet half the cost of drilling operations which showed promise of yielding new geological information and would help the search for petroleum in Australia. There are also useful taxation concessions to companies and shareholders. The total financial assistance to be given will amount to £A500,000 per year and so far allocations this year amount to £A164,730. All drilling operations to be undertaken, and to qualify for the subsidy, must be approved by the officers of the Bureau of Mineral Resources.

A statement by the Minister for Mines indicates large-scale activity in the search for oil in the State, in 1959, by organizations of repute in Canada and the United States. A stratigraphic well will be commenced on Wreck Island for Humber Barrier Reef Oils, Ltd., and Santos-Delhi Australian Co. is preparing to drill a similar well to a depth of 14,000 ft. at Innamincka, on the Queensland–South Australian border. A drilling rig has been brought from Exmouth Gulf, Western Australia, and has been unloaded at Port Adelaide for transport to the drill site. The National 130 rig, comprising about 1,000 tons

of equipment, will be transported by motor trucks in convoys of eight. To January 1 of this year 551,740 sq. miles of country in the State were held under oil-prospecting titles and other applications covered a further 200,000 sq. miles. Under the terms of the titles all areas must be properly prospected.

Frome Broken Hill Co. has applied for a 10,000 sq. mile exploration permit in Central Australia. The area extends from the South Australian border north to within 20 miles of Alice Springs and is just south of the locality where a heavy flow of gas was struck when sinking a well on a cattle station. The company will have two geological parties in the field for six months and the investigation is considered to be the biggest undertaken in the Northern Territory so far. Shareholders in Frome Broken Hill are Interstate Oil, Ltd., Zinc Corporation, Ltd., Vacuum Oil Co., Ltd., and British Petroleum, Ltd.

Drilling in New Zealand will be commenced in the Taranaki district this month by interests comprising the B.-P. Shell Group and Todd Petroleum Development, Ltd. At the same time a seismic survey is being carried out in the Gisborne district by the same groups interested. Six mobile drilling rigs are engaged in the Gisborne operations. The combined costs of the two operations is stated at £N.Z.1,500,000. In the past 50 years several companies have drilled for oil in the Gisborne area but previous work has never approached the scale of the present operations.

Tin in Tasmania.—A merger between Aberfoyle Tin and Storey's Creek—two Tasmanian tin-wolfram mining companies—is being arranged and their operations will be combined. In the Aberfoyle mine lodes are contracting at depth and the life of the mine can be assessed. It is a producer of both metals with a fine record. Storey's Creek is considered to be one of the important mines of the Commonwealth, with wolfram as the major mineral. It has been worked on a limited scale in the past but has modern equipment. The merger will assist tin production to some extent, but as the principal product will be wolfram the state of the tungsten market will be important to the joint project.

FEDERATION OF MALAYA

February 10.

Malayan Mining.—Tin mining remains the largest and most important interest of the Malayan mining industry, although in recent years the production of certain other minerals has become increasingly important, according to the Federation Annual Report for 1957, recently published. There had been mounting interest in iron mining as a result of a steady demand from Japan which, however, showed signs of slackening towards the end of the year, while in the face of competition from imported oil the production of coal again decreased. The total value of all minerals exported during the year was $(Malayan)444,400,000, on which export duty amounting to $61,495,000 was paid. The corresponding figures for 1956 were $464,000,000 and $65,520,000.

Tin.—As formerly, the major part of the tin ore won was produced from alluvial deposits in certain favoured areas. The Kinta valley in the State of Perak remained the most productive tinfield. This State produced 60·7% of the total, while 29·2% was mined in Selangor. Lesser amounts were produced in Negri Sembilan, Pahang, Johore, Perlis, Kedah, and Malacca. Dredging, undertaken only by European-managed companies, was the largest source of production, but a major contribution was made by Chinese gravel-pump mines; lesser contributions came from open-cast mines, both Chinese and European. The one large underground mine in east Pahang remained the only important underground producer. The production of tin concentrates in 1957 was 1,322,869 piculs, with a calculated tin metal content of 59,293 tons, the lowest production since 1953. In compliance with the Federation's obligations under the International Tin Agreement, collection of the first instalment to the Buffer Stock, which had commenced on October 15, 1956, was continued until October 14, 1957, and $30,771,000 was collected at the rate of $24 a picul of tin concentrates delivered or exported. In December the second instalment was called up and the second collection period was declared to commence on December 15, 1957. To assist miners in difficulties as a consequence of the payment of Buffer Stock contributions the Government granted "hardship loans" up to 60% of the contributions paid; 165 such loans totalling $1,644,205 were granted during the year.

The Report says that while the decline in the production of tin could in part be attributed to the effect of Buffer Stock contributions and the introduction of tin control in December, it could also to some extent

New Runway, Hong Kong Airport.

(Fdk. Parker, Ltd.)

be attributed to the increasing difficulty of finding workable deposits of ore. As a result of the improved position in the war against the Communist terrorists in the Malayan jungles a considerable amount of prospecting had been possible but to date the results had been disappointing, no new important deposits having been discovered. Having regard to the natural tendency to prospect the most promising areas first and the large amount of prospecting and fossicking that had been carried out during the last half-century, it would appear prudent to assume, the report suggests, that unless and until evidence to the contrary was produced that the discovery of further extensive tinfields was unlikely. It therefore appeared probable that in the years to come increased attention would be paid to the reworking of old areas by improving mining methods.

Iron.—Production and export of iron ore again increased to record amounts. Of the production of 2,972,359 tons, 2,919,739 tons, valued at $65,560,472 were exported; $5,889,169 was paid in royalty. The Bukit Besi mine of Eastern Mining and Metals Co., Ltd., in Trengganu, with a production of 2,255,164 tons was again responsible for the bulk of the output. At the end of the year one mine was producing in Kedah, three in Perak, and two in Johore. Keen interest was shown in prospecting for iron, particularly in Johore, and there seemed to be some prospect of the development of new mines. In the past the location and production of ore of sufficient purity had, at times, been a difficulty and this factor was likely to be of importance in the future development of the industry. Most of the iron ore exported went to Japan.

Aluminium.—Production of bauxite again increased, to 325,629 tons, as compared with 264,444 tons in 1956. The bulk of the production came from the mine of Ramunia Bauxite, Ltd., at Telok Ramunia, Johore, but 45,728 tons were produced from the adjoining mine of South East Asia Bauxites, Ltd. Japan was the best customer, taking 306,984 tons.

Gold.—Raw gold production at 11,157 oz. showed a marked decline compared with the 1956 production of 20,253 oz. and was the lowest since 1948.

Columbium.—Production of columbite continued on a reduced scale; of the total of 142 tons, 115 tons came from Bakri in Johore and 27 tons from Semeling in Kedah. A total of 101·6 tons valued at $504,867 was exported and $44,114 was paid in export duty.

Tungsten.—There was a decline in production of tungsten minerals to 49 tons, as compared with 91 tons in 1956. Totals of 30 tons of scheelite and 19 tons of wolfram were produced. Exports were 38·7 tons of wolfram and 3·83 tons of scheelite, valued at $147,617 and on which $8,427 was paid in export duty.

Titanium.—Ilmenite was produced on a considerable scale as a by-product of tin mining. Exports were 91,734 tons, valued at

$3,619,541, on which export duty amounting to $366,980 was paid.

China Clay.—Production of china clay increased from 1,155 tons to 1,510 tons. Most of this was used locally in the manufacture of rubber goods.

Monazite.—This mineral is recovered as a by-product of tin mining. A total of 490 tons valued at $504,477 was exported. Export duty paid was $56,409.

Other Minerals.—Totals of 1,815 tons of copper concentrates, valued at $208,689, and 41 tons of zircon, valued at $822, were exported.

Uranium in Malaya.—Following the aeromagnetic survey by Canadian experts of 16,000 sq. miles of Malaya ground teams have been checking some of the findings. Interim reports from the teams have indicated that radioactive minerals exist only in scattered surface deposits, according to Inche Bahaman bin Samsuddin, Malaya's Minister for Natural Resources.

He is quoted as saying : " In view of this, extraction would be a very uneconomical proposition. It has been found that none of the deposits would justify the expense of the costly mining equipment required."

There had been hopes that the survey would result in the unearthing of uranium deposits.

Bauxite.—Ramunia Bauxite, Ltd., of Singapore, will have an additional production capacity of 100,000 tons annually when its new washing plant is brought into operation.

The plant, supplied by Humboldt Deutz, A.G., of Hamburg, West Germany, is for a mine at Telok Ramunia, Johore. This mine's present output of about 250,000 tons of bauxite a year is exported mainly to Japan.

Cement Factory.—A new cement factory being built at Batu Caves, near Kuala Lumpur, Malaya, is expected to be ready to start production in July. Initial output is planned to be about 2,500 tons of cement a month, which will later be stepped up to 4,000 tons a month.

JOHANNESBURG

February 25.

Recruits for the Mines.—In his recent presidential address to the Association of Mine Managers, Mr. W. D. Lyle commented that while the outlook is less satisfactory the present European complement of the gold-mining industry does not reflect an undue shortage, although wastage among underground officials remains very high. Learner officials in service declined to 337 in 1958 from 455, but the standard of the recruits had risen. Miner trainees enrolled by the training schools had declined to 1,162 from 1,598, while graduates in mining had declined steadily over the past five years, averaging only 11 a year over the past three years. While the summer school introduced by the industry in 1957 has experienced some teething troubles, these do not explain the poor results obtained by those attending. A similar tendency has been recorded by engineering or artisan apprentices in trade tests, despite selection through aptitude tests, the introduction of apprentice supervisors, and other changes for better training. One reason submitted is that qualification as journeyman is not conditional on a pass in the trade tests. Many overseas recruits have now attained official rank in the mines—a considerable proportion being shift bosses, several mine captains or overseers, and one recently obtained the mine manager's certificate. Mr. P. H. Anderson, president of the Chamber of Mines, commented that there are encouraging aspects : Improved domestic recruiting for the training schools which, however, has so far failed to offset less recruiting overseas, limited largely to Holland and Italy. Recruiting there has been delayed (or interrupted) by negotiations over procedures for the resumption of recruiting. The outlook is stated to be promising.

Gold-Mining Industry.—During 1958 the Rand mines milled 38,704,850 tons of ore, against 39,931,900 in 1957, but the gold yield rose from 8,409,480 oz. to 8,448,770 oz. The gold-uranium properties crushed 26,837,500 tons in 1958, as compared with 26,182,500 tons in the previous year, and produced 8,705,235 oz. of gold and 12,108,143 lb. of U_3O_8, against 8,131,337 oz. of gold and 11,081,546 lb. of U_3O_8 in 1957. The higher gold yield in 1958 was due mainly to the higher grade treated by the new mines, a tendency that has not yet reached its peak. As some of the new mines extend their operations underground the grade may decline, but in the aggregate the yield should rise as milling rates are expanded.

Union Affairs.—Assets held by external interests in South Africa at the end of 1956 were valued at £1,396,400,000, according to revised and adjusted returns of the census of

assets and liabilities of the territory taken in 1957. The largest holder of these assets was the United Kingdom, with £865,600,000. For the census the territories of the Union of South Africa, South-West Africa, and the three British Protectorates of Swaziland, Bechuanaland, and Basutoland were considered as one economic unit.

While the South African Railways had an operating surplus of about £2,826,000 in the seven months to the end of October last, equivalent to about £4,850,000 for a full year, appropriations for the Betterment Fund, the Pensions Fund, and the special contribution to the Renewals Fund are expected to result in a very substantial overall deficit by the end of March, 1959. An intensified economy programme is being conducted, but even with this it is unlikely that the year will end with a surplus. The expected deficit will probably have to be financed from the Treasury revenue account or by loans. In view of the fact that under the present conditions of economic recession the carrying capacity of the railways has become adequate for requirements it is possible that both the fiscal and railways budgets will reflect a slowing down in the rate of railway development and expansion, a longer period for its implementation, or a scaling down of less essential elements. While borrowing conditions overseas have improved in respect of the interest-rate factor, it is not expected that the Government will resort to any extensive loan issue to finance any deficit.

Over 1958 the total value of imports increased to £555,973,000 from £549,836,000. Exports declined to £384,517,000 from £451,699,000; these and the following returns excluded gold sales, which improved to £221,869,000 from £216,893,000. Individual export figures, with the 1957 figures in brackets, included: Mining machinery, £4,498,641 (£5,437,600); chromite, £2,971,723 (£3,544,782); lead concentrates (re-exports), £6,438,428 (£10,651,490); manganese ore, £5,061,226 (£5,676,416); fire-refined and blister copper, £6,432,015 (£7,518,601); asbestos, £10,416,003 (£10,953,895); coal (mainly anthracite), £1,663,160 (£1,440,185); diamonds (including re-exports), £30,682,638 (£34,822,719); radioactive minerals, £53,207,263 (£49,988,632); bunker coal and ships' stores, £7,742,846 (£15,119,984).

Reported as reflecting the continuation of a policy to maintain the postal, telephone, and telegraph services as a self-supporting Government department and the impact of higher salary and wage charges and increased costs of transport, equipment, stores, and supplies, certain postage rates—in respect of the African Postal Union and surface-mail rates generally, excluding parcel post—and telephone rates and rentals have been raised, with effect from April 1 this year. Without these increases the Minister of Posts and Telegraphs has estimated that the 1958–59 loss would have been about £1,000,000.

Transvaal.—Few details have been released about the companies engaged in prospecting in the Ventersdorp-Coligny zone to the north of Potchefstroom, in the Western Transvaal. In addition to the Anglo American Prospecting Co. (Africa), Ltd., which in association with the Unified Gold and Exploration Co., Ltd., has taken up options over about 43,200 claims west of Ventersdorp, other mining companies are in the field. The participation of the Unified company in the 43,200 claims is 20% in the vendor and subscription rights. Drilling operations have been in progress for some months. It has been unofficially reported that a gold-bearing horizon has been located at about 5,000 ft. The Unified company also has coal rights over about 2,600 acres in Kliprivier County, Natal, in the vicinity of which another company is drilling for coal.

Blyvooruitzicht Gold Mining, with two hoisting shafts in the central section and a relatively shallow ventilation shaft in the north-central section sub-outcrop zone, has decided to sink another, deeper ventilation shaft from a point about 3,200 ft. east of the first ventilation shaft, just north of the sub-outcrop zone in country rock. This second ventilation shaft, 24 ft. in diameter, lined, will be sunk to 5,045 ft., the 6-level horizon, with which it will be connected by cross-cuts to provide for adequate ventilation of deeper-level workings, to stabilize future underground pumping arrangements, and to improve winding facilities, which indicates that the hoisting capacities of the two hoisting shafts may be increased. The shaft has been sited in country rock to avoid locking up substantial tonnages of high-grade ore in a shaft-pillar. The estimated cost of sinking the shaft over a period of about 4½ years will be £2,720,000, including £465,000 on pumping equipment.

Experiments in the correlation of data derived from an aeromagnetic survey conducted by African Surveys Co., in association with its United States' affiliate, Aero Services of Philadelphia, with that already known of a

zone of 2,000 sq. miles on the Far West Rand, have been conducted recently. The results were interpreted in a report by the consulting geologist of the companies mentioned, W. B. Agocs, of the United States, delivered to the Geological Society of South Africa in Johannesburg. A feature of the air survey is the very considerable saving of time over that of an equivalent ground survey.

The Verolite Asbestos is changing its name to Verolite Mining, is reconstructing its capital structure, offering new shares for subscription, realizing an interest in Orient Manganese, and applying the proceeds and the issue of additional shares to the repayment of a loan, at the same time acquiring Ermelo Collieries as a wholly-owned subsidiary.

Springbok Colliery, Ltd., which has an output capacity of about 75,000 tons a month of high-grade steam coal from its 12-ft. No. 2 seam and has established a new colliery with a washing plant to produce about 65,000 tons a month of blend coking coal from its 5-ft. No. 5 seam, recently raised additional finance through a share issue to repay the loan raised to finance the above expenditure, to finance a degree of mechanization in the No. 2 seam operations, and to provide for the eventual establishment of a third colliery for exploiting more remote areas of the No. 5 seam.

Orange Free State.—The recent decline in development values at Western Holdings, Ltd., has been due to relatively greater development effort being switched from higher-grade zones north of No. 1 and south of No. 2 shafts to the relatively lower-grade zone between the two shafts. In developing towards the new No. 3 shaft in the western section, a limited footage, 200 ft., disclosed 1,000 in.-dwt. in a rise from 33 level, midway between the two shafts.

No final consideration has yet been given to the methods whereby Welkom Gold Mining will repay its loan of £2,500,000 to the Anglo American Corporation, which falls due at the year end. The company hopes to effect this without adverse effect on dividends paid by it.

Cape Province.—The Monazite and Mineral Ventures Co., in the Anglo American group, will place its mine in the Van Rhynsdorp area of the North-Western Cape on a caretaking basis from March 31, 1959. The company's contracts then lapse, have not been renewed, and other sales outlets have not been secured. Casual demands will be met from a small stock of concentrates. Sales of the concentrates, mainly on account of the nuclear thorium content, are effected through the S.A. Atomic Energy Board, or by permit therefrom. In 1957 sales were valued at £682,879.

Consolidated African Mines, Ltd., which acquired control of a number of small manganese producers in the Postmasburg area, reports that economies effected through the centralization of operations and administration have enabled the company to meet the competitive conditions prevailing and to show a profit on a restricted output of 3,000 tons to 4,000 tons a month, while advancing exploratory work. A market has been secured for production of high-grade iron ore, the first shipment of which has been effected.

Trade Notes

Brief descriptions of developments of interest to the mining engineer.

Floating Suction Strainer

A novel suction strainer of interest to users of pumps drawing water from streams or in the unwatering of mines and excavations was recently demonstrated in London. Known as the Dolphin floating suction strainer it has been developed by **Megator Pumps and Compressors, Ltd.,** of 43, Berkeley Square, London, W. 1. It is so designed that it will remain upright and floating (Fig. 1) no matter how much the hose to which it is attached

Fig. 1.

may twist or turn. Fig. 2 shows the salient features. The tube to which the hose is secured can rotate freely in the body, which is all plastic. The float chamber moreover is filled with a moulding of expanded polystyrene foam, which provides millions of separate water-tight air cells whereby buoyancy cannot be lost as a result of accidental damage. The entire strainer is constructed from plastics and austenitic stainless steel, so that it is for most practical purposes immune from corrosion. The plastics used are of an extremely tough and resilient type, so that the strainer is well able to withstand very rough handling and its rounded shape, flat bottom, and freedom from projections make it well adapted to being hauled about on the end of the hose.

Its design overcomes another difficulty encountered in some pumping problems—namely, the tendency for air to be entrained into the pump suction due to vortex. This can put a pump out of action. Experience so far indicates that the Dolphin strainer prevents the formation of vortices, first, by reason of the cylindrical disposition of the entry holes and, secondly, because any tendency to vortex formation is automatically countered by a slight sinking of the strainer so that a vortex-free position of equilibrium is established.

The strainer is made in four sizes for hose diameters of 1½ in., 2 in., 3 in., and 4 in.

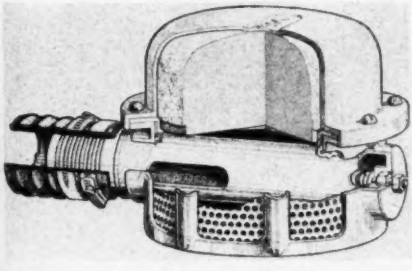
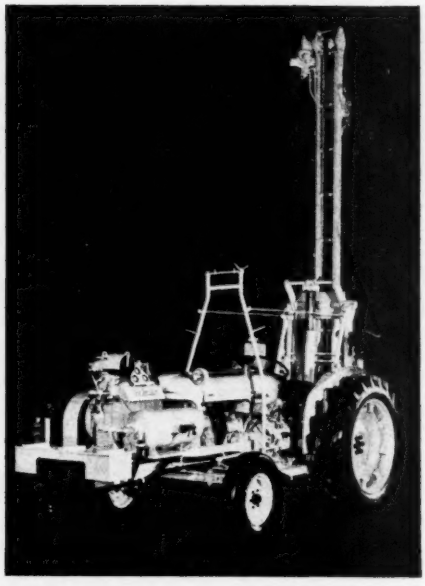


Fig 2.

Hole-Drilling Rig

This latest addition to the Holman range of products comprises a Fordson Major tractor, a Climax vole drill, a Holman air-compressor, and Maxam pneumatic control equipment. Thus the combination is self-contained and self-propelled and suitable for operation on difficult and uneven ground. The unit can be worked by one man. The 3¼-in. drill, capable of drilling to 150 ft., is mounted to the rear of the tractor on a fabricated channel and angled steel structure. Attached to this structure by means of a pivot is a rigid beam which carries at the top a 3-h.p. piston-type air hoist motor. A 3-h.p. rotation motor, also of piston type, is secured

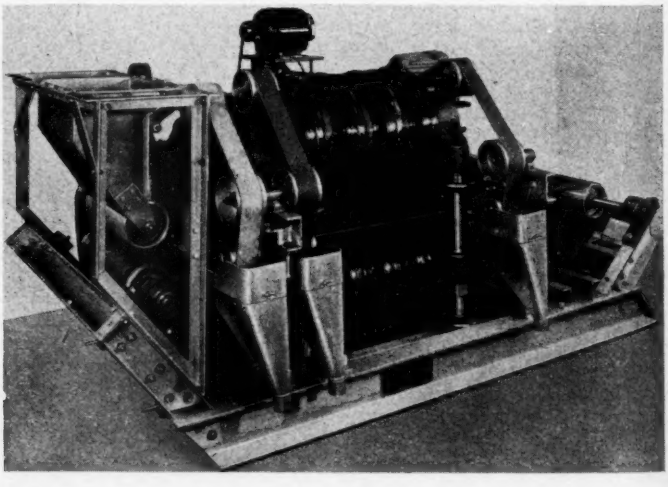


to a platform which runs in slides attached to the beam and to it are attached the feed tubes (10 ft. by 2½ in. diameter). As drilling progresses the rotation motor descends in the slides until a new feed tube is required. To allow this to be fitted the hoist motor is brought into use to raise the rotation motor on its platform. At the base of the vertical member the feed tube passes through an automatic centralizer-clamp, which is actuated by two Maxam air cylinders controlled by a hand-operated valve and serves to steady and guide the hammer when the hole is started and also facilitates adding or removing lengths of feed tube by clamping between two square jaws the flats at the end of the feed tube. This information is supplied by **Holman Bros., Ltd.,** of Camborne, Cornwall.

Unit Magnetic Separator

A magnetic separator of the cross-belt type which has been manufactured for many years by the Fraser and Chalmers Engineering Works of the **General Electric Co., Ltd.,** at Erith, Kent, has recently been redesigned as a unit machine. This now has two pairs of poles for removing the magnetic mineral and a single auxiliary pole for removing steel particles, etc., when required, the construction being such that any number of units can readily be linked up in series.

The magnetic flux is generated by eight coils, four on the upper magnet and four on the lower, designed to take a current of 3A at 110V d.c. A 15-in. feed belt carries the mineral through the air gap between each pair of poles and the upper poles are tapered and fitted with tips of high-permeability alloy, which has the effect of concentrating the lines of force at the pole tips and producing a magnetic field of great lifting power. The feed belt is driven by its own motor through a P.I.V. (positive infinitely variable) chain gear, which gives it a speed range from 20 to 240 ft./min. The cross-belts are driven by a separate motor through a variable-



G.E.C. Magnetic Separator.

speed gear and can be regulated between 250 and 1,000 ft./min.

The upper poles of the magnet are carried on an assembly which is independent of the main frame and is supported on four posts with adjusting handwheels. The spacing between each pair of poles can thus be set accurately and independently to suit the mineral to be separated. Since the cross-belts and their pulleys are mounted on the same assembly they do not have to be re-adjusted if it should be necessary to alter the air gap. The framework of the machine, including the upper assembly, is of aluminium, while the posts and handwheels are of brass. Leakage of magnetic flux is thus almost entirely eliminated and virtually all the flux can be concentrated in the space between the poles. A field strength as high as 18,000 gauss is possible at belt level with a ¼-in. gap between the upper and lower poles. This concentration, combined with the converging field induced by the special pole tips, affords great lifting power and permits minerals of extremely low magnetic susceptibility to be separated.

Personal

L. W. ADSHEAD, manager of President Steyn, has been transferred as manager to East Daggafontein, in succession to N. G. HARPER, who is retiring through ill-health. G. THORBURN, assistant manager, has been appointed manager of President Steyn.

J. F. DEAR is now in Johannesburg.

P. P. EDWARDS is returning from India.

J. R. FINLAY has been appointed operations manager at North Broken Hill, Ltd.

W. E. FITZPATRICK has been appointed deputy manager of North Broken Hill, Ltd.

M. GREEN is returning from Malaya.

H. E. HOWARD has been appointed a director of the Heidelberg Estates and Exploration Co., Ltd.

R. V. HUGHES has been appointed professor of petroleum engineering at the Colorado School of Mines.

J. C. LORETTO is now in Kenya.

D. L. MARRIOTT is returning from Kenya.

W. R. MILLER has retired as assistant manager of North Broken Hill, Ltd.

J. PENHALE is home from Sierra Leone.

P. G. SMYRK has been appointed joint managing director of Johnson, Matthey and Co., Ltd.

T. D. WEATHERHEAD has been appointed managing director of Hunting Aerosurveys, Ltd., in succession to Mr. F. L. WILLS.

Sir ALEXANDER SPEARMAN, who died in London on February 11, aged 77, was trained at the Camborne School of Mines. He went to Western Australia in 1902, but after four years on various gold mines he returned to England on his way to Siberia, where he carried out some inspection work for Central Siberia, Ltd. In the years from 1908 to 1913 Sir Alexander worked in Ceylon, Burma, and the United Kingdom before leaving for Assam, where he remained until 1918. There followed engagements in various parts of the world before his retirement from mining.

MARCEL BALLAY, president and managing director of the Centre d'Information du Nickel, Paris, died on February 2, aged 62. Dr. Ballay started work in metallurgy in the laboratory of the de Dion plant, of which he became head in 1925. In 1928 he joined the Centre d'Information du Nickel as technical manager, becoming vice-president in 1950 and president in 1954, succeeding M. JEAN DHAVERNAS. In 1935 he was promoted to the rank of "Chevalier de la Légion d'Honneur" in recognition of his qualities as a technical professor and, in 1955, the rosette of "Officier de la Légion d'Honneur" was conferred upon him in recognition of his services to industry and to the teaching profession.

INSTITUTION OF MINING AND METALLURGY

Elections and Transfers

Member.—Harold T. BERRY, B.Sc. (*Falconbridge*); Marshall Frederick STANSMORE (*Macalder, Kenya*).

Associate Member to Member.—Vero Louis BOSAZZA, D.Sc. (*Johannesburg*); Peter Audley DELMÉ-RADCLIFFE, A.C.S.M. (*Batu Gajah*); Nicholas Zalmon GOLDBLATT (*Johannesburg*); Owsley Lafayette GRAY (*Insu, Ghana*); Noel Wilfrid GRIFFIN, B.Sc., A.R.S.M. (*Penang*); Reginald William JIGINS (*Savell, Chile*); Lloyd Samuel JONES, A.O.S.M. (*Greymouth, N. Zealand*); Petros Georgiou PETROPOULOS, A.C.S.M. (*Nicosia*); James Lestock REID, B.Sc. (*Luanshya*); Eric Alfred SWANSON, B.Sc. (*Buchans*); Arthur Leonard THOMAS, A.C.S.M. (*Camborne*); Donald Lindsay TURNBULL (*Mufulira*).

Associate.—John Edward BUTLER (*Kalalushi*); Michael Edward COSGROVE, B.Sc. (*Southampton*); George Eveleigh DAVIES, B.Sc. (*London*); James Roy FARRANT, B.Sc. (*Teheran*); Frank Alan GARNER, B.Sc. (*Kaduna, N. Nigeria*); Graham Francis Rouse GEORGE (*Nkana*); Cecil George HAWKINS, A.C.S.M. (*Bukeru, N. Nigeria*).

Student to Associate Member.—John William BIRCH, B.Sc., A.R.S.M. (*Elliot Lake*); Norman Michael Benjamin BLACKBURN, A.R.S.M. (*Jos*); Geoffrey Dean BROWN, A.C.S.M. (*Cerro de Pasco*); Deryk Oughton GILBEY, B.Sc., A.R.S.M. (*Kitwe*); William Cecil GREGORY, B.Sc., A.R.S.M. (*Leeds*); John Robert HOATSON, A.C.S.M. (*Chingola*); Antony James MICHELL, A.C.S.M. (*Chunya, Tanganyika*); Karel de Haas OPPERMAN, A.C.S.M. (*Kitwe*); Robert Gardner PENNINGTON, A.C.S.M.

(*Carnforth*); John Harvey POWNALL, B.Sc., A.R.S.M. (*Harwell*); Terence RODGERS, Ph.D. (*Montreal*); Ian Alexander SANDERS (*San Louis Potosi*); Kenneth Barry SMALE-ADAMS, A.C.S.M. (*Welkom*); Robert William STEVENS, B.Sc., A.R.S.M. (*Leicester*); Frank Idris THOMAS, A.C.S.M. (*Chingola*); Leslie Reginald VERNEY, B.Sc. (*Mufulira*); Derek Leonard WARD, A.C.S.M. (*Kitwe*); George Douglas Rogers ZAREMBA, A.C.S.M. (*Nyanza, Kenya*).

Affiliate.—James Anderson MEIKLE (*Camborne*); M. H. Raghvendra RAO (*Mysore*).

Student.—John Fraser ADAMSON (*Chalfont St. Giles*); David BARHAM (*London*); Ronald David BENNETT, A.C.S.M. (*London*); Hamilton John Cotterell BRIDGENS (*Upminster*); Thomas Edward BURNS (*North Harrow*); Alan Kenneth BURTON (*Camborne*); Michael John BUTLER (*Staines*); D. Michael Ian CALLOW (*Worcester Park*); John Bernard COOK (*Watford*); Anthony Robert COX (*London*); Ian Alexander DONALD (*Dunedin*); Roy A. FARRAR (*Erith*); Abraham David GOODMAN (*London*); John GOULBOURN (*Aylesbury*); William Richard GRIEVE (*Saffron Walden*); Derek Michael HADDRILL (*Ilkley*); Geoffrey David HALLETT (*Newport*); John Richard HAMILTON (*Street, Somerset*); Sydney Malcolm HARTY (*Camborne*); David George Fenwick HEDLEY (*London*); Richard Antony HOWARD (*Brightwell-cum-Sotwell*); John HUMPHRISS (*Ruislip*); Colin Thomas McINTOSH (*London*); John Gordon Nicol NAPIER (*Kirkcaldy*); Michael Ernest PARKER (*Mansfield*); James William PLATT (*London*); Andrew ROBERTSON (*Pinner*); Trevor SCARRATT (*West Hartlepool*); Barrie Millard SCOTT, B.Sc. (*Kitwe*); Courtenay Vivian SMALE (*St. Columb*); Roger TAYLOR (*Sheerness*).

Metal Markets

During February [1]

Copper.—In the early part of February copper prices [2] remained on the soft side after the metal had become somewhat overvalued on the fears of labour trouble in Chile. However, as it happened these fears were justified, as a strike broke out at Cerro de Pasco's Chilean mine; this appears to be in the process of settlement as this report is written. More important from the point of view of its effect on market sentiment was the wave of trouble amongst African labour. This source of anxiety started a little while ago in the Belgian Congo and, although the big copper producer there pointed out that the troubles were some considerable distance from the mines, the market has been keeping a weather eye lifting. The outbreak of further riots in Rhodesia and Nyasaland, therefore, caused anxiety for the Copperbelt although as far as can be seen the main disturbances are some way away.

Another labour talking point that is growing into increasing prominence is the possibility of a strike at United States mines and plants in July, when the current labour contract runs out. Already American fabricators have taken quite considerable strides in the direction of covering themselves against any possible shortfall in supplies in the summer and in Europe there is increasing evidence that the broad copper supply position is much less easy than it was.

However there are exceptions to the general pattern. It is no secret that part of the good consumption figures of the U.K. industry recently, and especially last year, was accounted for by the sales of copper wire which it has been possible to make to Russia. Now that it is permissible to export primary copper forms to Russia, at least from Europe, that country's demand for wire and wire rod has shrunk considerably. One advantageous effect of this trend has been the halting of a declining trend in Metal Exchange warehouse stocks and throughout February stocks have advanced, although not yet to a point at which a regular contango is assured. Another point bearing on supplies in London has been the re-imposition of restrictions on exports of primary copper from the U.S.A., which were relaxed in 1956. This means that American copper cannot be put on warrant in London, as this does not comply with providing an end-use certificate.

Copper consumption in the U.K. in December was 56,698 tons, bringing the total for the year to 667,978 tons, a worthwhile advance over the 641,484 tons consumed in 1957. Virtually all the increase was accounted for by increased consumption of refined copper. Production of primary refined was 8,073 tons and of secondary refined 9,232 tons. Stocks of blister fell steeply to 14,281 tons and of refined rose slightly to 49,903 tons.

Tin.—Several items of interest have occurred in the tin market in February. In the first place the International Tin Council at its meeting in London decided to advance the quotas for the second quarter of 1959 to a total of 23,000 tons. In the second place it was made known shortly afterwards that all the metal acquired with the Special Fund had been sold, so that the way is now clear for the Buffer Stock manager to make sales from his holdings whenever he wishes in view of the fact that prices are now likely to be around £780 per ton for a little while.[1] Meanwhile, the Singapore price continues to maintain a healthy premium over London. It remains to be seen, however, what will happen at the beginning of the new quota period in April, especially in view of the fact that some Malayan mines are reported likely to re-open now that the quota is bigger and prices are higher. A key to future movements in tin prices is likely to be the level of stocks in Metal Exchange warehouses, as these will broadly reflect sales from Buffer Stock holdings.

U.K. December consumption was 1,802 tons, making a year's total of 20,413 tons, a little under the 21,787 tons used in 1957. December output was 2,396 tons.

Lead.—Lead has remained a largely uninteresting market in February and prices [1] have remained very closely centred on £70 per ton. Both lead and zinc have displayed a dogged ability to hang on at certain levels, in an inconspicuous way, in a manner which has surprised many people. Certainly the dice are loaded against lead, as production appears to have been cut back rather less than that of zinc, at the same time that consumption has presented a picture of even more unrelieved gloom. The good

[1] Recent Prices, pp. 136, 176.
[2] See Table, p. 176.

[1] See Table, p. 176.

performance of the motor industry in the U.K., for example, is now of more immediate advantage to zinc than to lead as of course new car batteries are only a part of the outlet for lead in this direction.

As the year progresses, it will be possible to see exactly how far America can go on restricting imports without London being affected. In the view of many people this is not long.

U.K. lead consumption in December was 27,154 tons, making a 1958 total of 335,920 tons—a large part of the drop from 1957 being accounted for by the cable trade. December output was 7,792 tons English refined and end-month stocks 45,577 tons.

Zinc.—Zinc has managed to look up a little in February, prices improving gradually to give a net gain of £3 per ton.[1] It is fair to say, however, that this trend is a source of surprise and is attributable to the particular position of g.o.b. metal, which is, of course, the basis of the London market. High-grade zinc is in easy supply and although the prophets have been largely proved wrong by the turn of events so far it is hard to see how the zinc price structure in Europe can remain as it is at present.

U.K. December zinc consumption was 26,042 tons and 1958 total 306,070 tons, over 10,000 tons under 1957, a margin entirely accounted for by galvanized sheets. December output was 6,829 tons and stocks rose to 37,094 tons.

Iron and Steel.—Steel production in the United Kingdom has settled down around the 75% of capacity mark and it would seem as if the worst of the recession were over. The recovery, however, may be a long time coming and already the forecasts of better conditions by mid-year look like being inaccurate. Many people in the steel industry see no real revival in business until the autumn or the end of the year. It is expected that the durable consumer goods industries will be the first to find improved activity; the heavy engineering industries are likely to remain in low gear for rather longer. The demand for sheets from the motor industry is maintained at a high level. Interest in tinplate is strong. An interesting development announced in February is the first delivery of tinplate in coil form in this country.

The steel industry continues its export sales pressure on a much shrunken world market but unfortunately suffered a setback in January when exports fell to 214,310 tons from 278,807 tons in December and 238,426 tons in January, 1958. Imports, meanwhile, continue to dwindle in volume and in January totalled a mere 25,906 tons, of which over a third was composed of ferro-alloys and a large part of the remainder of sheet steel. Imports are now the lowest for many years.

Iron Ore.—Although U.K. imports of iron ore in January rose a little from December—to 1,016,376 tons from 987,183 tons—they were well below the figure of a year ago of 1,276,115 tons. Total 1959 imports may well be below the previous year's arrivals of 12,910,000 tons.

Aluminium.—February was a dull and uneventful month for aluminium, the only price movement being at the beginning of the month when French producers raised the domestic price of primary metal by 7%. This move took the price to 224,000 francs per metric ton for 99·99·49% primary ingots. The new price is for 10-ton lots f.o.r. St. Jean de Maurienne.

[1] See Table, p. 176.

However, while the new metal market remains static with plentiful supplies of metal at a fixed price, the reverse side of the picture—secondary metal—provides an interesting contrast. During the month pressure on scrap aluminium prices continued to increase and it would appear that further advances will be seen in the very near future. Naturally enough ingot makers are not at all happy about this situation as it has caused them to raise their prices to cover higher production costs. Their anxiety to keep prices down stems from the fear of competition from other materials in the motor and other industries. However, it appears that the upward trend of scrap prices may not be halted or slowed down unless there is a falling off in the demand for ingots or pressure of demand eases for some other reason.

The Eire Government has made an Order imposing a customs duty of 37½% (full) and 25% (U.K. and Canada) *ad valorem* on imported aluminium strip, sheet, and foil. A further Order exempts from duty aluminium strip, sheet, and foil of more than one-fiftieth of an inch thick imported prior to July this year.

The price of aluminium ingots 99·5% Canadian delivered in the U.K. remains unaltered at £180 per long ton.

Antimony.—Nothing of interest occurred in this market during February and prices of all grades of material from all sources remain unaltered from those in existence at the end of January.

English regulus is quoted at £197 10s. a ton.

Arsenic.—Once again this market was quiet, with business passing at normal levels. Imports of arsenic trioxide during January totalled 183 tons, as compared with 450 tons in the same month of 1958. The prices of both metal and trioxide are unaltered at £400 and £40–£45 a ton respectively.

Bismuth.—This market was not overtaken by any striking events during February and the price of bismuth remains unchanged at a nominal quotation of 16s. per lb.

Imports into the U.K. during January amounted to 109,017 lb., against 98,913 lb. in the same month last year.

Cobalt.—Since the price reductions which became effective on February 2 there has been no change to record in this market. Despite the lower prices business does not appear to have been stimulated as was probably hoped by sellers.

Imports during January totalled 105,512 lb., while those of January, 1958, amounted to only 81,025 lb. The price of cobalt is 14s. per lb.

Cadmium.—The price of cadmium remains unaltered in a quiet market at 9s. 6d. per lb. This price applies to both imported and United Kingdom metal. However, consumption of this metal in this country during 1958 was up on the previous year's; total consumption in 1958 was 1,024 tons as compared with 963 tons in 1957. The largest consumer was the plating anode industry followed by colour makers.

Chromium.—There have been no movements in this normally quiet market and the price of metal is quoted at 6s. 11d.–7s. 4d. per lb.

Tantalum.—For sometime past there has only been one effective buyer of tantalite—an American firm. This concern is obviously well supplied and has sharply lowered its buying prices recently. Current market indications are 650s.–700s. per unit, but a further decline is possible.

Platinum.—February was certainly a lively month for platinum, particularly in view of the fact that this market has been quiet and depressed for some time. Around the middle of the month leading U.K. sellers moved their price up to £21 5s.—previously £19 10s.—per troy oz. This move was occasioned by an almost overnight upward move in the price of imported metal following the withdrawal of Russian metal from the market. This occasioned a burst of semi-panic buying and the price of U.K. metal was moved up again, this time to £25 a troy oz. This is where it is at the moment, although how long it will stay there or which way it will go when it alters is really anyone's guess. On the open market isolated transactions at as high as £27 have been reported.

Iridium.—Despite the almost hysterical urge to buy platinum there has been no more than the usual lukewarm interest in iridium. The price remains at £19–£21 per troy oz.

Osmium.—The same comments apply to this metal as apply to iridium except that the price is £16–£17 per troy oz.

Palladium.—Palladium also escaped the buying rush and emerged from February with its price structure virtually unaltered. Quotations are still around £5–£5 15s. per troy oz.

Tellurium.—This metal can be dismissed as far as market movements are concerned and sent to join the many other not-so-popular metals in an obscure corner. During February there was no alteration in the situation and the price remains quoted at 15s.–16s. per lb.

Tungsten.—During the majority of the month the tungsten ore market was thoroughly depressed and although there was a little business transacted about the middle of the month nothing further materialized and prices at the close of February were down to 84s.–89s. per long ton unit of WO_3.

Nickel.—Following the disappearance of the free nickel market in June, 1958, there no longer seems to be any really interesting news to report on nickel. The Inco strike is over, as previously reported, and the market seems to be just standing still.

The price in the U.K. stands at £600 a ton.

Chromium.—Despite the reduction in freight rates there has still not been any parallel reduction in the price of chrome ore. However, an adjustment is expected at any time now. Of greatest interest to the market in February was the announcement that the U.S. Government was to discontinue its bartering for chrome ore. The effect of this decision on the market has not yet shown and it will be interesting to see the reaction of producers. Metallurgical grade 48% ore is quoted at £15 15s. a ton.

Molybdenum.—There has been no change in this market during the past month and 85% material f.o.b. Climax Colorado is still quoted at 8s. 11d. per lb. of metal contained.

Manganese.—Early in the month it was learnt that B.I.S.C. (Ore) has bought all its requirements of manganese ore for the current year. This does not of course mean that vast quantities have been acquired as stocks were quite heavy at the beginning of the year. The B.I.S.C. (Ore) acquisition is based on a steel output of 19,500,000 tons and unless this figure is eventually exceeded prospects for any further buying in this country would appear to be slight. Ore of 46–48% is quoted at 77d. per unit of metal contained.

Tin, Copper, Lead, and Zinc Markets

Tin, minimum, 99·75% ; Copper, electro ; Lead, minimum 99·75% ; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Feb. 11	770 0	769 5	232 7½	232 12½	69 13¾	70 8¾	73 6¼	71 7½
12	768 10	768 15	234 7½	234 12½	69 18¾	70 11¼	73 1¼	71 7½
13	769 0	769 5	236 17½	236 10	69 11¼	70 8¾	73 2½	71 8¾
16	771 0	771 15	237 17½	237 17½	69 17½	70 13¾	73 15	72 2½
17	772 0	772 10	236 17½	236 17½	69 17½	70 17½	74 6¼	72 8¾
18	772 0	772 15	235 17½	235 17½	69 11¼	70 11¼	74 6¼	72 5
19	772 10	774 5	237 7½	237 2½	70 2½	71 3¾	74 16¼	72 15
20	775 0	776 10	236 17½	236 17½	69 18¾	71 1¼	74 16¼	72 12½
23	772 0	774 5	238 7½	238 7½	70 2½	71 2½	75 7½	73 7½
24	774 0	775 15	239 12½	239 7½	69 7½	70 11¼	75 16¼	72 18¾
25	781 10	783 5	240 15	240 7½	69 11¼	70 13¾	75 3½	73 3¾
26	784 0	785 5	240 10	239 17½	69 2½	70 7½	74 12½	72 7½
27	782 0	784 10	240 5	239 12½	69 5	70 17½	75 8¾	73 3¾
Mar. 2	781 10	783 15	240 17½	240 12½	70 18¾	71 17½	75 11¼	74 2½
3	781 0	784 10	245 7½	244 17½	70 17½	71 17½	75 11¼	74 3¾
4	780 10	783 0	246 2½	245 17½	71 2½	72 8¾	75 17½	74 2½
5	780 0	783 5	247 15	247 2½	71 12½	73 1¼	76 11¼	74 16¼
6	779 0	781 5	245 5	244 7½	71 1¼	72 12½	75 17½	74 3¾
9	777 0	779 5	248 2½	247 17½	71 12½	72 17½	75 16½	74 2½
10	780 10	782 15	248 15	248 7½	71 3¾	72 12½	75 16¼	74 2½
11	—	—	—	—	—	—	—	—

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	January		February	
	Treated Tons.	Yield Oz.†	Treated Tons.	Yield Oz.*
Blyvooruitzicht	106,000	69,704	108,000	70,987
Brakpan	140,000	16,500	126,000	15,194
Buffelsfontein‡	122,000	41,674	126,000	43,028
City Deep	117,000	24,446	107,000	22,366
Cons. Main Reef	118,000	20,116	110,000	19,050
Crown Mines	232,000	35,826	203,000	32,286
Daggafontein	227,000	46,426	230,000	47,035
Doornfontein‡	88,000	36,520	87,000	35,579
D'rb'n Roodeport Deep	190,000	34,694	175,000	32,232
East Champ D'Or‡	12,000	284	11,500	238
East Daggafontein	91,000	15,110	92,500	15,355
East Geduld	137,000	42,141	123,000	37,823
East Rand P.M.	223,000	57,169	201,000	52,000
Eastern Transvaal Consol	19,000	6,283	18,900	6,157
Ellaton‡	30,000	7,079	30,000	7,091
Freddies Consol.	57,000	13,754	53,000	13,594
Free State Geduld	73,000	55,663	75,000	57,335
Geduld	72,000	12,790	66,000	12,335
Government G.M. Areas‡	64,000	10,958	51,000	10,302
Grootvlei Proprietary	205,000	43,451	190,000	40,385
Harmony Gold Mining	112,000	44,802	102,000	40,920
Hartebeestfontein‡	86,000	46,870	84,000	45,570
Libanon	98,000	23,220	96,000	22,840
Loraine	73,000	14,418	75,000	14,625
Luipaards Vlei‡	120,000	13,776	117,000	13,759
Marievale Consolidated	90,000	22,857	83,000	21,179
Merriespruit‡	—	—	—	—
Modderfontein East	141,000	13,541	127,000	12,221
New Kleinfontein	84,000	11,004	78,000	10,167
New Klerksdorp‡	8,900	988	9,700	1,060
President Brand	95,000	72,418	95,000	72,584
President Steyn	94,000	36,566	93,000	36,382
Rand Leases	181,000	26,698	181,000	26,960
Randfontein‡	189,000	13,257	173,000	12,838
Rietfontein Consolid't'd.	16,000	4,348	16,000	4,252
Robinson Deep	66,000	14,110	64,000	12,802
Rose Deep	38,000	5,619	36,000	5,210
St. Helena Gold Mines	140,000	40,741	135,000	40,507
Simmer and Jack	90,000	17,200	84,000	16,791
S. African Land and Ex.	90,000	18,935	90,000	18,900
S. Roodepoort M.R.	31,000	7,440	28,000	6,762
Spaarwater Gold	10,700	3,314	10,500	3,301
Springs	104,000	14,220	99,000	13,740
Stilfontein Gold Mining‡	125,000	63,875	127,000	64,770
Sub Nigel	66,500	15,907	64,000	15,267
Transvaal G.M. Estates	7,700	1,907	6,300	1,868
Vaal Reefs‡	78,000	35,491	78,000	35,495
Van Dyk Consolidated	78,000	14,695	71,000	13,394
Ventersspost Gold	123,000	31,279	125,000	31,631
Village Main Reef	27,000	4,895	26,300	4,782
Virginia O.F.S.‡	114,000	29,070	115,000	29,325
Vlakfontein	50,000	17,929	48,500	17,386
Vogelstruisbult‡	90,000	20,610	90,000	20,570
Welkom Gold Mining	90,000	27,482	90,000	27,762
West Driefontein‡	82,000	78,319	84,000	78,508
West Rand Consol.‡	206,000	20,893	194,000	—
Western Holdings	100,000	60,001	100,500	60,304
Western Reefs	110,000	29,051	110,500	28,730
Winkelhaak	71,000	16,245	66,000	15,246
Witwatersrand Nigel	18,100	4,374	17,400	4,213

† 249s. 7d. * 249s. 9d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Dec.,* 1957	16,198,500	64 4	46 1	18 3	23,695,380
Jan., 1958.	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.*	15,806,300	64 10	46 6	18 4	23,170,987
April	—	—	—	—	—
May	—	—	—	—	—
June*	16,435,500	64 9	46 6	18 3	24,358,945
July	—	—	—	—	—
August	—	—	—	—	—
Sept.*	16,760,400	65 10	46 9	19 1	25,633,898
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	16,540,150	67 7	47 10	19 9	25,934,441

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
March, 1958	1,394,956	36,330	1,431,286
April	1,401,094	38,352	1,439,446
May	1,435,960	36,494	1,472,454
June	1,408,384	39,187	1,447,571
July	1,456,925	42,312	1,499,237
August	1,463,259	36,413	1,499,672
September	1,465,697	36,799	1,502,496
October	1,516,701	44,025	1,560,726
November	1,484,844	32,349	1,517,193
December	1,480,525	40,372	1,520,897
January, 1959	1,506,670	39,515	1,546,185
February	1,472,090	34,618	1,506,708

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
June 30, 1958	334,882	31,336	366,218
July 31	336,356	31,608	367,964
August 31	334,815	31,924	366,739
September 30	333,380	31,978	365,358
October 31	335,003	32,657	367,660
November 30	332,443	32,851	365,294
December 31	329,234	32,946	362,180
January 31, 1959	350,656	—	—
February 28	396,217	33,859	430,076

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To Feb. 7		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	11,180	1,797	2,242
Electrolytic Zinc	13,280	518	3,734
Lake George	22,445	1,662	3,255
Mount Isa Mines**	81,572	5,060†	2,118
New Broken Hill	36,820	6,476	7,838
North Broken Hill	14,338	2,422	2,646
Zinc Corp.	37,980	6,704	7,267
Rhodesia Broken Hill*	—	—	—

* 3 Mths. ** Copper 3,240 tons. † Metal.

RHODESIAN GOLD OUTPUTS

	January		February	
	Tons	Oz.	Tons	Oz.
Cam and Motor	31,853	—	31,570	—
Falcon Mines	20,000	3,732	20,000	3,700
Globe and Phœnix	6,000	3,378	6,000	2,889
Motapa Gold Mining	19,200	1,844	—	—
Mazoe	2,678	—	2,601	—
Coronation Syndicate	12,016	—	12,063	—
Phœnix Prince*	—	—	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	January		February	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	61,769	14,775	65,094	14,492
Ariston Gold Mines	39,000	12,198	39,000	12,726
Ashanti Goldfields	33,750	26,000	34,000	26,000
Bibiani	33,500	7,200	35,500	7,200
Bremang	—	4,528	—	4,695
Ghana Main Reef	11,480	4,492	11,441	4,491
Kononga	6,330	3,746	6,550	3,760
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1958		1959	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,305	46,553	46,489	18,077
February	43,591	21,313	—	—
March	43,830	8,179	—	—
April	46,587	22,573	—	—
May	46,015	19,937	—	—
June	46,453	20,105	—	—
July	44,244	19,170	—	—
August	47,484	20,549	—	—
September	48,295	21,141	—	—
October	46,311	6,342	—	—
November	47,904	16,435	—	—
December	48,888	30,724	—	—

WESTRALIAN GOLD PRODUCTION

	1957	1958	1959
	Oz.	Oz.	Oz.
January	106,722	66,562	63,924
February	64,949	65,965	—
March	67,121	65,420	—
April	66,435	60,855	—
May	64,886	64,196	—
June	65,142	67,929	—
July	74,420	81,106	—
August	75,727	68,610	—
September	64,422	68,744	—
October	64,524	70,128	—
November	65,700	67,562	—
December	66,562	120,106	—
Total	846,610	867,187	—

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Jan. 20		To Feb. 17	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,056	6,894	13,862	7,266
Crœsus Proprietary	—	—	—	—
Gold Mines of Kalgoorlie	36,758	9,300	40,074	12,081
Golden Horse Shoe*	—	—	—	—
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	32,216	6,557	29,915	5,000
Hill 50*	—	—	—	—
Kalgurli Ore Treatment	—	—	—	—
Lake View and Star*	—	—	—	—
Moonlight Wiluna*	—	—	—	—
Morning Star (G.M.A.)	1,003	381	—	—
Mount Ida*	—	—	—	—
New Coolgardie	—	—	—	—
North Kalgurli	27,100	5,374	27,065	6,174
Sons of Gwalia	7,542	1,730	—	—
Mount Morgan	—	5,783	—	6,640

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
September, 1957	722,384	105,471	34,248	6,947,813
October	772,383	224,217	37,086	7,657,426
November	756,494	219,352	37,737	7,441,702
December	750,537	215,462	44,230	7,494,289
January, 1958	779,128	219,502	31,562	7,462,598
February	727,170	210,646	35,370	7,248,333
March	807,458	229,361	38,323	7,873,264
April	785,264	228,590	35,712	7,789,644
May	801,102	228,123	37,535	7,745,425
June	775,384	228,960	42,275	7,740,144
July	750,410	218,126	38,940	7,355,406
August	740,459	202,798	31,543	7,006,517
September	771,115	209,006	34,914	7,178,218
October	801,965	230,251	35,097	7,842,435
November	783,065	219,351	30,989	7,490,094
December	787,573	227,656	41,277	7,700,672

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	Jan.		Feb.	
	Tons	Oz.	Tons	Oz.
British Guiana Cons.	—	—	—	—
Central Victoria Dredging	—	—	—	—
Clutha River	—	—	—	507
Emperor Mines (Fiji)*	—	—	—	—
Frontino Gold (Colombia)	—	—	—	—
Geita Gold (Tanganyika)	—	—	—	—
Harrietville (Aust.)	—	—	—	—
Lampa (Peru)†	—	37,887	—	—
Loloma (Fiji)*	—	—	—	—
New Guinea Goldfields	4,333	1,168	—	—
St. John d'el Rey (Brazil)	—	—	—	—
Yukon Consol.	—	—	—	—

* 3 Months. † Oz. Silver : Copper, 111 : 67 tons.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	Dec.	Jan.	Feb.
Ampat Tin	66	—	43½
Austral Amalgamated	—	—	—
Ayer Hitam	132*	—	—
batu Selangor	—	—	—
Berjuntai	136½	128½	137½
Chenderiang	19*	—	—
Gopeng Consolidated	92*	—	—
Hongkong Tin	—	—	—
Idris Hydraulic	26*	—	—
Ipoh	47*	—	—
Jelapang Tin	—	—	—
Kampong Lanjut	37	52	47
Kamunting	95	67	66
Kent (F.M.S.)	35*	—	—
Kepong	—	—	—
Killinghall	47*	—	—
Kinta Kellas	—	—	—
Kinta Tin Mines	52*	—	—
Klang River	—	—	—
Kramat	47	—	—
Kuala Kampar	87	125	106
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	—	—	—
Lower Perak	48½	17	67
Malayan	266*	—	—
Malaysiam	—	5	5½
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	37½*	—	—
Pengkalen	51*	—	—
Petaling Tin	228½	—	—
Puket	—	—	—
Rahman Hydraulic	60*	—	—
Rambutan	20½*	—	—
Rantau	30½	61	38
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	113*	—	—
Selayang	39*	—	—
Siamese Tin Syndicate (Malaya)	12	13	25½
Southern Kinta	328	278½	218
Southern Malayan	416*	—	—
Southern Tronoh	—	—	—
Sungei Besi	144*	—	—
Sungei Kinta	35*	—	—
Sungei Way	183*	—	—
Taiping Consolidated	21	30	26
Tambah	—	—	—
Tanjong	115*	—	—
Tekka	17*	—	—
Tekka-Taiping	—	—	—
Temoh	124*	—	—
Tongkah Compound	—	—	—
Tongkah Harbour	29	—	35½
Tronoh	406†	—	—
Ulu Klang	—	—	—

* 3 months. † Grouped Quota.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	January		February	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines ..	216	30	174	—
Anglo-Burma Tin *	16	—	—	—
Bangrin	63	—	30	—
Beralt	45	131†	40	101†
Bisichi	43½	6	48½	13
Ex-Lands Nigeria	40	—	31	—
Geevor	62	—	55	—
Gold and Base Metal	30	1	—	—
Jantar Nigeria	16	20	14	18
Jos Tin	11½	—	—	—
Kaduna Prospectors	4	—	3	—
Kaduna Syndicate	15	—	13	—
Katu Tin	13	—	23	—
Keffi Tin	—	—	—	—
London Nigerian Mines	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	4½	—	—	—
Naraguta Karama	5½	—	—	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria)	7	½	—	—
Siamese Tin Syndicate	15	—	13	—
South Bukeru	—	—	—	—
South Crofty	81	—	73	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	4	1	—	—

* 3 months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

December, 1958.

Gold	1,517,024 oz.
Silver	151,633 oz.
Diamonds	206,665 carats.*
Coal	3,535,748 tons.
Copper	(*a*) 10 tons in matte and copper-gold concentrates. (*b*) 4,435 tons of 99·34%.
Tin	242 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	15,912 tons.
Chrome Ore	60,775 tons.
Manganese Ore	92,116 tons.
Lead Concs.	— tons.

* Nov., 1958.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		December	January
Iron Ore	tons	987,183	1,016,376
Manganese Ore	„	29,165	22,810
Iron and Steel	„	31,596	25,906
Iron Pyrites	„	16,546	19,739
Copper Metal	„	38,200	39,960
Tin Ore	„	5,790	2,576
Tin Metal	„	317	324
Lead	„	23,248	19,620
Zinc Ore and Conc.	„	7,099	27,979
Zinc	„	13,753	15,083
Tungsten Ores	„	549	573
Chrome Ore	„	7,053	11,406
Bauxite	„	17,550	26,766
Antimony Ore and Concs.	„	1,159	1,058
Titanium Ore	„	18,306	26,983
Nickel Ore	„	—	—
Tantalite/Columbite	„	83	39
Sulphur	„	31,041	32,496
Barytes	„	3,398	2,469
Asbestos	„	12,692	7,232
Magnesite	„	1,066	1,386
Mica	„	390	285
Graphite	„	520	421
Mineral Phosphates	„	122,595	78,151
Molybdenum Ore	„	320	104
Nickel	cwt.	5,982	10,839
Aluminium	„	370,213	358,207
Mercury	lb.	99,186	179,680
Bismuth	„	88,370	104,985
Cadmium	„	218,484	210,455
Cobalt and Cobalt Alloys	„	58,019	105,512
Selenium	„	7,821	8,308
Petroleum Motor Spirit	1,000 gals.	69,071	57,362
Crude	„	871,118	838,617

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
„ „ 80% Technical	„	97	0	0
Alum, Comml.	„	25	0	0
Aluminium Sulphate	„	16	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	59	0	0
„ Chloride, 98%	„	26	0	0
„ Phosphate (Mono- and Di-)	„	102	0	0
Antimony Sulphide, golden	per lb.		3	0
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate (native), 94%	„	Nominal		
„ Chloride	„	53	0	0
Barytes (Bleached)	„	20	0	0
Benzene	per gal.		5	2
Bleaching Powder, 36% Cl.	per ton	30	7	6
Borax	„	44	0	0
Boric Acid, Comml.	„	75	10	0
Calcium Carbide	„	40	17	9
„ Chloride, solid, 70/75%	„	13	5	0
Carbolic Acid, crystals	per lb.		1	6
Carbon Bisulphide	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	1½
Citric Acid	per cwt.	11	0	0
Copper Sulphate	per ton	74	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, refined	„		6	10
Hydrochloric Acid 28° Tw.	per carboy		13	0
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate	per ton	3	17	6
Lead, Acetate, white	„	124	0	0
„ Nitrate	„	116	0	0
„ Oxide, Litharge	„	106	5	0
„ Red	„	104	5	0
„ White	„	116	0	0
Lime Acetate, brown	„	40	0	0
Magnesite, Calcined	„	20	0	0
„ Raw	„	9	0	0
Magnesium Chloride, ex Wharf	„	16	0	0
„ Sulphate, Comml.	„	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.		6	3
Nitric Acid, 80° Tw.	per ton	37	10	0
Oxalic Acid	„	129	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Pine Oil	per ton	Nominal		
Potassium Bichromate	per lb.		1	2½
„ Carbonate (hydrated)	per ton	74	10	0
„ Chloride	„	21	0	0
„ Iodide	per lb.		7	3
„ Amyl Xanthate	„	Nominal		
„ Ethyl Xanthate	„	Nominal		
„ Hydrate (Caustic) flake	per ton	118	0	0
„ Nitrate	per cwt.	4	1	0
„ Permanganate	per ton	193	10	0
„ Sulphate, 50%	„	20	13	0
Sodium Acetate	„	99	0	0
„ Arsenate, 58–60%	„	Nominal		
„ Bicarbonate	„	15	0	0
„ Bichromate	per lb.		1	0
„ Carbonate (crystals)	per ton	Nominal		
„ „ (Soda Ash) 58%	„	13	15	0
„ Chlorate	„	91	0	0
„ Cyanide 100% NcAN basis	per cwt.	6	6	6
„ Hydrate, 76/77%, solid	per ton	33	0	0
„ Hyposulphite, Comml.	„	32	15	0
„ Nitrate, Comml.	„	29	0	0
„ Phosphate (Dibasic)	„	40	10	0
„ Prussiate	per lb.		1	0½
„ Silicate	per ton	11	0	0
„ Sulphate (Glauber's Salt)	„	9	15	0
„ „ (Salt-Cake)	„	10	0	0
„ Sulphide, flakes, 60/62%	„	38	12	6
„ Sulphite, Comml.	„	27	10	0
Sulphur, American, Rock (Truckload)	„	15	0	0
„ Ground, Crude	„	17	10	0
Sulphuric Acid, 168° Tw.	„	10	10	0
„ „ free from Arsenic, 140° Tw.	„	8	0	0
Superphosphate of Lime, 18% P_2O_5	„	14	18	6
Tin Oxide	„	Nominal		
Titanium Oxide, Rutile	„	172	0	0
„ White, 25%	„	85	0	0
Zinc Chloride	„	95	0	0
„ Dust, 95/97% (4-ton lots)	„	109	0	0
„ Oxide	„	95	10	0
„ Sulphate	„	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	Feb. 10, 1959 £ s. d.	Mar. 10, 1959 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	3 14 3	3 18 9
Blyvooruitzicht (2s. 6d.)	1 3 0	1 4 9
Brakpan (5s.)	5 0	5 0
Buffelsfontein (10s.)	2 7 3	2 6 6
City Deep	16 6	16 6
Consolidated Main Reef	17 3	18 0
Crown Mines (10s.)	1 6 0	1 4 9
Daggafontein (5s.)	1 9 0	1 7 3
Dominion Reefs (5s.)	15 0	14 9
Doornfontein (10s.)	1 10 9	1 11 0
Durban Roodepoort Deep (10s.)	1 13 0	1 13 3
East Champ d'Or (2s. 6d.)	2 0	2 0
East Daggafontein (10s.)	8 6	8 6
East Geduld (4s.)	1 3 6	1 2 6
East Rand Ext. (5s.)	1 7 6	1 8 9
East Rand Proprietary (10s.)	2 3 0	2 1 3
Freddies Consol.	3 3	3 3
Free State Dev. (5s.)	9 9	10 3
Free State Geduld (5s.)	7 4 3	7 12 3
Free State Saaiplaas (10s.)	18 0	17 6
Geduld	3 5 0	3 2 6
Government Gold Mining Areas (4s.)	4 3	4 3
Grootvlei (5s.)	17 6	17 6
Harmony (5s.)	2 3 9	2 1 0
Hartebeestfontein (10s.)	3 3 6	3 5 6
Libanon (10s.)	9 3	9 3
Loraine (10s.)	1 14 9	1 11 9
Luipaards Vlei (2s.)	9 3	9 3
Marievale (10s.)	1 5 3	1 5 6
Merriespruit (5s.)	7 6	6 3
Modderfontein B (3s.)	2 3	2 3
Modderfontein East	14 9	15 9
New Kleinfontein	4 9	4 6
New Pioneer (5s.)	2 0 6	1 19 6
New State Areas (15s. 6d.)	2 0	2 0
President Brand (5s.)	3 8 3	3 2 3
President Steyn (5s.)	1 14 9	1 11 6
Rand Leases (10s.)	6 9	7 6
Randfontein	1 5 3	1 4 6
Rietfontein (3s. 2d.)	7 3	5 9
Robinson Deep (3s. 6d.)	8 9	7 9
Rose Deep (6s. 6d.)	12 9	13 0
St. Helena (10s.)	2 19 0	2 14 3
Simmer and Jack (1s. 6d.)	3 3	3 0
South African Land (3s. 6d.)	1 1 0	1 0 9
Springs (5s.)	1 9	1 9
Stilfontein (5s.)	2 7 9	2 5 0
Sub Nigel (8s. 6d.)	15 3	13 9
Vaal Reefs (5s.)	1 19 9	1 18 6
Van Dyk (7s. 9d.)	4 3	4 9
Venterspost (10s.)	16 3	16 6
Virginia (5s.)	9 0	8 6
Vlakfontein (10s.)	18 3	17 6
Vogelstruisbult (10s.)	8 6	8 3
Welkom (5s.)	1 0 6	18 3
West Driefontein (10s.)	5 14 3	5 17 6
West Rand Consolidated (10s.)	1 5 6	1 4 0
West Witwatersrand Areas (2s. 6d.)	3 13 3	2 13 6
Western Holdings (5s.)	6 15 0	6 10 0
Western Reefs (5s.)	1 11 0	1 8 0
Winkelhaak (10s.)	1 1 3	1 0 3
Witwatersrand Nigel (2s. 6d.)	1 3	1 3
Zandpan (10s.)	19 9	1 0 6
RHODESIA:		
Cam and Motor (2s. 6d.)	8 0	8 0
Chicago-Gaika (10s.)	15 0	15 0
Coronation (2s. 6d.)	4 3	4 0
Falcon (5s.)	7 6	7 6
Globe and Phœnix (5s.)	1 10 6	1 9 6
Motapa (5s.)	9	9
GOLD COAST:		
Amalgamated Banket (3s.)	1 2	1 0
Ariston Gold (2s. 6d.)	5 0	4 9
Ashanti Goldfields (4s.)	18 0	17 9
Bibiani (4s.)	2 6	2 3
Bremang Gold Dredging (5s.)	1 7	1 6
Ghana Main Reef (5s.)	2 3	2 0
Konongo (2s.)	1 9	1 9
Kwahu (2s.)	3 6	3 9
Western Selection (5s.)	5 6	5 9
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	2 0	2 0
Gold Mines of Kalgoorlie (10s.)	8 3	8 6
Great Boulder Propriet'y (2s.), W.A.	12 9	12 6
Lake View and Star (4s.), W.A.	1 4 0	1 3 9
London-Australian (2s.)	9	9
Mount Morgan (10s.), Q.	13 3	13 3
New Guinea Gold (4s. 3d.)	2 0	2 0
North Kalgurli (1912) (2s.), W.A.	10 6	10 0
Sons of Gwalia (10s.), W.A.	2 9	2 6
Western Mining (5s.), W.A.	10 0	10 0

	Feb. 10, 1959 £ s. d.	Mar. 10, 1959 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	1 15 0	1 15 0
Kentan Gold Areas	2 1 9	1 19 6
St. John d'el Rey, Brazil	4 6 3	3 15 0
Yukon Consolidated ($1)	4 4½	4 9
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	1 7 3	1 7 6
Esperanza (2s. 6d.), Cyprus	1 9	2 0
Indian (2s.)	4 6	4 3
MTD (Mangula) (5s.)	11 3	10 0
Messina (5s.), Transvaal	5 4 0	5 11 3
Mount Lyell, Tasmania	1 5 0	1 6 0
Nchanga Consolidated, N. Rhodesia	11 4 9	10 15 0
Rhokana Corporation, N. Rhodesia	29 0 0	26 5 0
Roan Antelope (5s.), N. Rhodesia	8 6	8 0
Tanganyika Concessions (10s.)	2 11 3	2 8 9
LEAD-ZINC:		
Broken Hill South (5s.), N.S.W.	2 6 0	2 6 0
Burma Mines (3s. 6d.)	2 3	2 3
Consol. Zinc Corp. Ord.	3 3 6	3 0 0
Lake George (5s.), N.S.W.	3 0	3 6
Mount Isa, Queensland (5s. Aust.)	1 12 0	1 10 6
New Broken Hill (5s.), N.S.W.	1 14 6	1 13 9
North Broken Hill (5s.), N.S.W.	3 15 0	3 15 0
Rhodesia Broken Hill (5s.)	8 9	8 9
San Francisco (10s.), Mexico	15 9	16 6
TIN:		
Amalgamated Tin (5s.), Nigeria	7 0	7 0
Ampat (4s.), Malaya	7 6	8 0
Ayer Hitam (5s.), Malaya	1 10 6	1 11 6
Beralt (5s.), Portugal	1 5 6	1 7 0
Bisichi (2s. 6d.), Nigeria	3 3	3 3
Ex-Lands (2s.), Nigeria	1 9	2 0
Geevor (5s.), Cornwall	17 0	19 3
Gold Base Metals (2s. 6d.), Nigeria	9	1 0
Hongkong (5s.), Malaya	4 6	4 3
Jantar Nigeria (3s.)	3 3	3 3
Kaduna Syndicate (2s.), Nigeria	2 1½	2 2
Kamunting (5s.), Malaya	10 3	10 9
Malayan Tin Dredging (5s.)	14 6	15 0
Mawchi Mines (4s.), Burma	1 6	1 6
Naraguta Extended (5s.), Nigeria	9	9
Pahang (5s.), Malaya	4 0	4 6
Siamese Synd. (5s.)	7 6	7 9
South Crofty (5s.), Cornwall	4 0	3 10½
Southern Kinta (5s.), Malaya	19 9	1 0 3
Southern Malayan (5s.)	12 3	12 6
Southern Tronoh (5s.), Malaya	11 3	11 6
Sungei Besi (4s.), Malaya	15 3	16 6
Sungei Kinta, Malaya	13 6	13 6
Tekka (12s. 6d.), Malaya	4 3	4 3
Tronoh (5s.), Malaya	12 6	12 6
United Tin Areas (2s. 6d.), Nigeria	4½	6
DIAMONDS:		
Anglo American Investment	10 11 6	11 2 6
Consol African Selection Trust (5s.)	16 6	15 6
Consolidated of S.W.A. Pref. (10s.)	10 6	10 6
De Beers Deferred (5s.)	6 8 6	6 2 6
FINANCE, Etc.		
African & European (10s.)	3 18 3	4 2 6
Anglo American Corporation (10s.)	8 19 9	8 10 0
Anglo-French Exploration	1 8 9	1 5 0
Anglo Transvaal 'A' (5s.)	2 1 6	2 0 9
British South Africa (15s.)	4 1 0	4 0 0
British Tin Investment (10s.)	19 6	19 9
Broken Hill Proprietary	2 2 0	2 3 0
Camp Bird (10s.)	10 0	12 9
Central Mining	3 19 9	3 11 9
Central Provinces Manganese (10s.)	1 11 0	1 12 6
Consolidated Gold Fields	3 8 9	3 4 9
Consolidated Mines Selection (10s.)	2 5 0	2 2 0
East Rand Consolidated (5s.)	1 9	2 0
Free State Development (5s.)	9 9	10 3
General Exploration O.F.S. (2s. 6d.)	5 9	5 3
General Mining and Finance	6 9 3	6 0 0
H.E. Proprietary (5s.)	16 3	16 0
Johannesburg Consolidated	2 17 9	2 16 6
London & Rhod. M. & L. (5s.)	8 6	7 9
London Tin Corporation (4s.)	8 3	8 3
Lydenburg Est. (5s.)	18 0	16 0
Marsman Investments (10s.)	1 6	1 9
National Mining	1 9	1 9
Rand Mines (5s.)	4 9 9	4 6 6
Rand Selection (5s.)	2 9 0	2 6 9
Rhodesian Anglo American (10s.)	4 5 0	3 18 9
Rhodesian Corporation (5s.)	3 9	3 6
Rhodesian Selection Trust (5s.)	17 3	16 6
Rio Tinto (10s.)	2 14 3	2 13 0
Selection Trust (10s.)	5 5 0	5 1 9
South West Africa Co. (3s. 4d.)	13 9	13 9
Union Corporation (2s. 6d.)	2 13 9	2 10 0
Vereeniging	6 10 0	6 0 6
West Rand Inv. Trust (10s.)	2 18 0	2 16 0

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Investigation of a Transvaal Diamond Occurrence

Bulletin 26 of the South African Geological Survey, by G. P. Fourie,[1] deals with diamond occurrences near Swartruggens, Transvaal. The accompanying summary in English says that the area concerned is situated from 4 miles to 7 miles north and north-east of the town Swartruggens, where a Mr. J. W. C. du Preez found the first diamond in 1933 or 1934. Shortly afterwards a preliminary geological investigation was undertaken by the Geological Survey and during 1955 the present investigation was carried out.

Diamonds are found in both kimberlite dykes and alluvial deposits, of which the former is the most important. Three dykes are exploited on portion A of the farm Nooitgedacht 405. They dip at steep angles towards the south and their thicknesses range from a few inches to about 6 ft., the average being about 3 ft. On portion B of the same farm alluvial diamonds were recovered during 1949. In addition, kimberlite dykes occur. These have been named after the persons who first exploited them. They are individually described in the report, all dykes ranging from a few inches to about 5 ft. in thickness, although the direction of dip is variable. During 1947 some prospecting was done on Nooitgedacht 405 and in the vicinity by Mr. Hardy, on behalf of the Government, and a leader of kimberlite close to the eastern fence of Eenzaamheid 380 was located. This may represent a continuation of Helam's dyke.

On Winkelhaak 280 prospecting pits, which most likely fall in line with the dykes on Nooitgedacht 405, were made. Three such dykes have been located, of which only one, the Main Dyke, is important. On Rustvoorby 895 all the prospecting trenches have been filled in. Since kimberlite was discovered on Koornfontein 881 in 1954 a certain amount of development took place. Kimberlite was found in various prospects, but up to 1955 no diamonds were found.

Alluvial Deposits.—In the vicinity of the kimberlite dykes on Nooitgedacht 405 and Winkelhaak 280 alluvial diamonds were found in superficial gravel; these deposits were worked out by the end of 1934. Most of the diamonds here were found over an area towards the north of the kimberlite dykes in the direction of the drainage system. The thick gravel deposits occurring on the banks of the Elands River on Rustvoorby 895 may be diamondiferous.

In the mine on Nooitgedacht 405 breccia zones from 6 in. to 24 in. wide occur in the Ongeluk lava of the Pretoria Series; the dip of the zones is 45° in a north-westerly direction. Both vein-quartz and kimberlite are present in these zones. Similar breccia from 6 in. to 72 in. wide is also present at greater depths in the mine. The dip is from 60° to 75° northwards. At places a dirty yellow carbonate is associated with the breccia.

Quartz veins occur in the Ongeluk lava. They are post-kimberlite in age and in general are parallel to the strike of the dykes.

Kimberlite

The kimberlite rock is composed mainly of phlogopite in a groundmass of calcite and other carbonates in addition to diamonds. The phlogopite has a zonal structure. Dark-red rounded pyrope, shiny black ilmenite, pyrite, pseudomorphous cubes of hæmatite, chlorite, and augite are all accessory minerals. Pieces of quartz and chert, as well as rounded pieces of lava and shale, are also found in the rock. The rock is dirty yellow and soft on the surface but becomes bluish green and harder at depth. All the types become friable when exposed to the atmosphere.

The types of diamonds vary from one mine to the next. In the Mallin mine most of the diamonds are of the industrial type, but in the Helam mine the jewel type is predominant. In the Josef and du Preez dykes the two types occur in about equal proportions.

Survey.—An electromagnetic survey was carried out in the vicinity of the Helam dyke and at other localities on the farm Nooitgedacht 405, as well as on the farm Winkelhaak 280 near van der Hoff's shaft. Some of the dykes and their continuations were indicated by anomalies, but in other instances hardly any anomalies were obtained in spite of the presence of the dykes.

The Helam Dyke and an east-west dyke past the van der Hoff's shaft could be traced, but other known dykes at the Helam mine could not be picked up.

Structural Relationship

The thickness of the dykes ranges within short distances from less than 1 in. to over 7 ft. They meander and split in many directions and every dyke may be considered as a network of smaller dykes. Dykes that do not appear on the surface have been found at depth. Calcite veins are ubiquitous. The predominant direction of strike is

[1] Pretoria: Department of Mines. Price 4s. 9d.

80° west of north. It is suggested that the intrusions follow a directed system of jointing that to a certain extent is coupled with the drainage system. It would appear that the dykes named Helam and du Preez and the one known as Pag 1, are continuous; these are also in line with van der Hoff's dyke. It is uncertain, however, whether some of the dykes are continuous, as outcrops are obscure. There is evidence that the dyke at Pag 2 may represent a split in depth of the one at Pag 3 and that no faulting took place. In general the dykes become thicker in depth and this fact and certain other facts concerning the orientation and concentration of the kimberlite dykes suggest the presence of an elongate deep-seated body of kimberlite on Nooitgedacht.

Production

The alluvial deposits have for the largest part been worked out and production now comes mainly from the dykes on the farm Nooitgedacht 405, which are worked by four separate companies. The diamond content of the kimberlite is fairly constant; it ranges between 1·25 carats and 1·75 carats per short ton. On Nooitgedacht 405 the value of the total production during the years from 1933 to 1945 (730,359 carats) was £1,300,214.

The greatest mining depth reached so far is approximately 600 ft. As most of the workings are much shallower it is evident that considerable reserves are present. As no decrease in productivity in depth is noticeable, a constant production of diamonds could be maintained for a long time.

References

(1) HAUGHTON, S. H., and NEL, L. T., "The Kimberlite Fissures Near Swartruggens." *Ongepubliseerde verslag van Die Geologiese Opname*, Pretoria, 1935.

(2) FOURIE, G. P., "Verslag oor die Geologie om Swartruggens." *Ongepubliseerde verslag van Die Geologiese Opname*, Pretoria, 1949.

(3) WAGNER, P. A., "The Diamond Fields of Southern Africa." *The Transvaal Leader, Johannesburg*, 1914.

Canadian Mining

In the course of a review of "Recent Canadian Developments in Mining and Metallurgy," appearing in the *Western Miner and Oil Review* for January, John Convey refers to new techniques for ore discovery and to improved mining methods.

In respect of discoveries the author says that Canada is fortunate in having many hundreds of thousands of square miles of largely unexplored and unprospected country underlain by rocks potentially favourable for the occurrence of mineral deposits, oil, and gas. Most of Canada, he says, is as yet geologically unmapped. Just 17 years ago only 11% of Canada was geologically mapped and at that time it was pointed out that with no increase in the speed of mapping it would take 800 years to map the remaining 89%, but within the past six years a great change in mapping methods has taken place. In this period, by the combined use of helicopters and conventional aircraft, more than 30% of the land area of Canada had been mapped at the end of 1957. A complete reconnaissance mapping of Canada probably within the next 25 years would permit a preliminary estimate of mineral potentialities, which at present, with more than two-thirds of the country geologically unmapped, is difficult to make.

Many of the recent mineral discoveries have been due to new geophysical techniques of locating ore-bodies at depth or under heavy overburden, in particular with the use of both surface-operated and air-borne magnetic and electronic instruments. Examples are the discovery of the iron-ore deposits at Marmora and Steep Rock, in Ontario, base metals at Lynn Lake and Moak Lake, in Manitoba, and at Bathurst, in New Brunswick.

New methods are being developed to overcome some of the difficulties involved in making mineral discoveries in Canada. One of these methods is that of using the very young, or perhaps one should say the rejuvenated, science of geochemistry. During the past year trace-element research on plants, river sediments, residual sediments, mantle material, and parent rocks has begun to fit together like a jig-saw puzzle. Early work dealt largely with such elements as zinc and copper, but recent investigations included such elements as molybdenum, cobalt, manganese, and nickel.

In the specific field of mining ore, says the author, the main technical developments of the past few years and what will continue in the future are associated with rock-drilling practices, the handling and mine transportation of ore, and new techniques in the support of mine workings. As the smaller high-grade ore-bodies become less numerous the trend is toward the mining of low-grade large-tonnage ore-bodies. Low-cost large-tonnage open-pit mining is worked if at all feasible. Modern large-scale equipment makes open-pit mining possible to-day that would have been impracticable a few years ago. With modern equipment huge tonnages of overburden and rock can be moved economically to expose the ore-body for mining. This is also true in coal mining. By these methods hundreds of tons of ore are mined per man shift, as compared with tens of tons by more selective methods.

The ever-increasing depths to which mining operations are being carried have been accompanied by greater stresses in the underground workings that increase the hazard to mining personnel and hinder the orderly and economical recovery of the mineral. Such stress manifests itself in a variety of ways, ranging from a slow extrusion of rock and mineral into the roadways to violent disturbances known to the coal miner as "bumps" and "outbursts of gas and coal" and to the metal miner as "rock-bursts." A bump or rock-burst causes sudden destruction of extensive portions of the mine workings, usually without warning, and is frequently associated with large areas of mineral extraction. An outburst of gas and coal is most frequently encountered in narrow roadways penetrating

virgin ores of a coal seam and is a large-scale explusion of broken coal into the roadways, accompanied generally by an enormous release of gas. In this latter type of disturbance the roof and floor strata are rarely damaged. Although these violent manifestations of stress relief are extremely hazardous to personnel they represent only the more spectacular phases of a general problem that usually expresses itself by a slower but continuous deterioration of mine workings.

The Mines Branch of the Department of Mines and Technical Surveys has undertaken a study into the various manifestations of ground-stress relief in underground workings in the hope of increasing the knowledge concerning them and thereby contribute toward the optimum recovery of Canadian mineral resources. The need for such study grows with the rapidly rising world demand for mineral products which accelerates depletion of the more readily accessible ores, particularly those of premium grade. For some of the new Canadian mining fields severe problems of ground stress are still in the future, but much of the country's mineral output comes from the older, well-established mines, which have already reached considerable depths. It must also be anticipated that the depletion of premium-grade deposits will eventually necessitate the mining, at competitive cost, of low-grade material and unsolved problems of ground control can very materially increase costs. A study into the phenomena of ground stress in underground workings is therefore considered to be a present-day necessity, especially since such an investigation must be undertaken as a long-term effort because of the very complex nature of the problem and the difficulty of making full-scale observations.

Mines Branch investigation into this and related subjects are conducted by a small team of mining engineers and physicists who, with assistance from geologists, endeavour to pool their special skills in an integrated programme of study. These Canadian investigations combine field and laboratory approaches.

Canada has enormous oil deposits in the tar sands of Alberta, but to date no profitable method has been developed to produce oil *in situ* from these McMurray oil sands when they are buried too deeply to employ surface-mining techniques. Unless some method is discovered to produce this oil economically, this potentially largest deposit of hydrocarbons known to the world will remain useless to the free world. Of the 17,000 sq. miles of area underlain by oil sand less than 2% has sufficiently small overburden cover to permit the employment of surface and conventional mining methods.

A careful study of available data obtained by the United States Atomic Energy Commission from their series of underground nuclear explosions indicates that in large areas where the oil sand is deeply buried, recovery of the oil may be effected by the heat and pressure liberated by nuclear detonations in or adjacent to the oil-sand bed. This proposal is receiving careful study by Canadian scientists, in co-operation with our colleagues in the U.S.A. and the Richfield Oil Corporation.

Low-Grade Oxidized Uranium

The " Beneficiation of Autunitic Ores," discussed by W. C. Aitkenhead and J. A. Jaekel in *Mining Engineering* for January, relates to the discovery of a successful collector. The authors say that the uranium deposits in the Spokane Indian Reservation, as well as those around Mt. Spokane, are essentially low grade, much of the ore containing less than 0·2% U_3O_8. The Mining Experiment Station of the Division of Industrial Research, State College of Washington, has been engaged in intensive research on the amenability of these low-grade ores to froth flotation. The results—successful flotation of autunite, chief mineral constituent.

At the outset of the work the goal was a concentrate of 1% U_3O_8 with a 90% recovery from ores containing less than 0·2% U_3O_8. Most of the work has been done on argillite ore from the Midnight mine on the Spokane Indian Reservation. The goal has not been attained using this ore, but samples of the granite ore from Mt. Spokane yielded successful results. For example, a concentrate containing 11·2% U_3O_8 was produced from a Mt. Spokane high-grade ore containing 1·27% U_3O_8, with a recovery of 97·8%. Another Mt. Spokane ore yielded a concentrate of 5·0% U_3O_8 from an ore containing 0·13% U_3O_8 with a recovery of 85%. This same ore gave a recovery of 93·5% when the grade of concentrate was reduced to 2·0%.

It has been concluded that a successful method for floating autunite has been developed and that the mediocre results from the Midnight argillite ore are probably caused by the presence of some other uranium mineral or minerals less amenable to the reagents.

The experimenters tested a third type of Washington ore, found on the Northwest Uranium Mines, Inc., property on the Spokane Indian Reservation. This is a conglomerate of pebbles and small boulders of partially decomposed granite and is shot through with autunite. Its characteristics lie between those of the Midnight ore and the granite ore from the Spokane district. It responds better than the ore from Midnight but not as well as that from Mt. Spokane.

As the fatty acids are the only type of collectors showing promise, investigation has been concerned with these acids and the optimum conditions for their use. The first method for treating the argillite ore from the Spokane Indian Reservation made use of Cyanamid's R-708 as a collector, a tall oil product described as a substitute for oleic acid. Although the investigators proved that R-708 is a collector for autunite when mixtures of autunite and silica sand are used, results on the ore were mediocre. Tests of other fatty acids revealed that the solid fatty acids of the saturated series are collectors for autunite and that their collecting power increases with the length of the carbon chain. The even carbon members of the whole series were tested from the 10 carbon acid (capric) to the 22 carbon acid (behenic). The least expensive collector, stearic acid (18 carbon), proved to be a good one, so this was used in most of the tests.

In first attempts with stearic acid the collector

was dissolved in various hydrocarbons and the solutions were added to the flotation cell. Cyclohexane, gasolene, fuel oil, kerosene, and other solvents were tried. Small amounts of high-grade concentrates could be brought up, but recoveries were low. Finally emulsions of stearic acid were tried. It was discovered that stearic acid alone has little collecting power except when conditioning is carried out at high temperature. When hydrocarbon solvents were also present, it proved to be an excellent collector. An example of one emulsion that proved satisfactory for some ores is given as follows: 1 part stearic acid by weight, 1 part sodium oleate by weight, 1·2 parts kerosene by weight, 100 parts water. In some successful tests part of the stearic acid was replaced by oleic acid. The emulsions were made by agitating the stearic acid and sodium oleate together with hot water, then adding the kerosene and agitating while cooling.

In five tests reported, 650 g. of ore were ground with 650 c.c. water in a laboratory rod-mill. The pulp was filtered to eliminate excess water and the ground ore transferred to a stainless-steel beaker for conditioning at high pulp density. In most of the tests sodium hydroxide was added to the conditioner during agitation, then the collector emulsion, and finally the sodium silicate. The amount of alkali was adjusted to give a pH of 8·5 to 9·0 in the flotation cell. After conditioning the pulp was transferred to a laboratory flotation cell and the test completed in a normal manner.

It is interesting to note that a deposit of high-grade concentrate forms on the conditioning agitator and in the conditioning vessel and at times on the agitator of the flotation cell itself. A few grammes of concentrate running as high as 4% U_3O_8 were recovered from the conditioner when Midnight ore containing less than 0·2% U_3O_8 was treated. In the examples given this conditioner concentrate is calculated as part of the total concentrate. The authors have not yet fully explored the possibility of making use of this tendency for the concentrate to stick to metallic surfaces.

On a sample of low-grade Midnight argillite ore, the most difficult of all ores tested, concentrates always contained large amounts of ferruginous slime and decomposed biotite mica, so the concentrate grade was invariably low. Low recoveries may have been due to nondescript uranium minerals in the extremely fine sizes. Tests on a conglomerate ore gave results better than those obtained on the Midnight sample but inferior to the good recoveries with high-grade concentrates that result from the Mt. Spokane granite ores.

Use of the stearic acid-kerosene emulsion has not been investigated as a collector for other uranium minerals more common than autunite. So far there have been no studies of concentrate cleaning and recirculation of the cleaner tailings, which should give a higher-grade concentrate with little or no sacrifice of recovery.

Mechanical Mining of Phosphate Rock

A progress report on the research into mining phosphate rock in America has been published as Report of Investigations 5437 of the United States Bureau of Mines. The authors—A. L. Service and T. E. Howard—deal with the "Design and Test Operation of a Pneumatic Vibrating-Blade Planer." It is pointed out that research to develop a low-cost, maximum-recovery method for underground mining of western phosphate rock and shale was begun in 1954 by the Bureau as part of its programme for promoting the conservation and development of domestic mineral resources. The major effort to date, it is stated, has been directed toward designing a continuous mining machine adaptable to the thin, inclined beds in which most of the minable western phosphate deposits occur. The present report presents the results of one additional period of test operation with the original minimum-design planer, referred to as model A, and a discussion of the design, construction, and test operation of a prototype production-model machine, designated model B, built early in 1957.

Experimental operation of model A was terminated May 10, 1956, and preliminary design work on model B was begun immediately. Construction was completed in May, 1957, and test operation was started on June 24, 1957, and continued until October 10, 1957. Although a few design flaws were indicated, in general, the performance of planer model B was satisfactory. It was demonstrated conclusively that phosphate rock of the type found in the Anderson mine was amenable to planer mining. However, high production and maximum efficiency could not be expected until supporting services, particularly ore disposal and ground support, were co-ordinated and the entire mining operation designed and geared to take full advantage of this system of mining.

The ore block at the Anderson mine selected for test operation was a portion of a large pillar left as part of a plan for orderly extraction of the ore between the 4,600 and the 4,800 levels, whereby large pillars were left at intervals as the level was advanced and recovered during retreat from the ore boundary. A rise 20 ft. wide had been driven from level to level in the centre of the pillar as part of the normal mine development.

To prepare a block for planer mining, slots or sub-level drives were driven south from the rise at the upper and lower ends of the block to open it on three sides. The top slot, about 20 ft. down dip from the 4,800 drive, was driven 30 ft. wide and timbered with a single row of stulls down the centre, set at 5-ft. intervals. The bottom slot was prepared by slashing from chute cut-outs previously driven as part of regular level development, leaving triangular pillars to direct the mined ore into the chute.

Equipment used directly for the planer operation consisted of three compressed-air utility hoists and headblock-support assembly. The main-pull hoist was rated at 3,500 lb. rope pull and was equipped with a long drum with a rope capacity of 800 ft. of $\frac{5}{8}$-in. wire rope. The other two hoists were rated at 2,500 lb. rope pull each and were used both as a double-drum slusher and to pull the planer back down to the bottom of the mining face after a cutting pass. The retrieve and slusher hoist assembly

was in the rise at about the midpoint of the mining face in order that the operator could have visual control over these operations.

In order to utilize the full width of the upper slot it was necessary that the headblock assembly be installed as close as possible to the up-dip side; therefore, in place of the screw jacks employed an I-beam was anchored to standard 48-in. expansion-shell rock bolts, installed in the foot-wall.

In addition to this equipment a small utility hoist was placed at the top of the rise for handling materials within the stope. The area was wired for electric lights to provide good visibility for the observing engineers and for safety. The entire operation was controlled by signals. Bells were installed at each hoist and at intervals along the mining face. A single cord, placed within easy reach of men stationed near the face, actuated the signals. A simple signal code was devised to control all phases of the operation. A series of trial runs were conducted between June 6 and June 24, 1957, to familiarize the crew with the operation of the planer and to test new design features before attempting a full-scale operation.

Overall productivity during the test was unimpressive, although the planer itself did well. Mechanically the machine proved to be satisfactory and it is expected that its efficiency will be increased with modification of the bedplate and use of a more powerful hoist. However, the arrangement of the auxiliary equipment and its control by signal could be improved. The two hoist operators could see very little of the operation and had to depend on the hose tender's signals. Also the crew could be reduced from three men to two by adding remote controls to operate the hoists and steer the planer. One operator could operate both hoists and the planer with strategically-located remote controls and have visual control of planing and ore disposal.

The design of the lower slot, with its triangular-chute pillars, proved to be a major bottleneck in moving ore within the stope. A sub-level drive equipped with a separate slusher to scrape ore into the chute would be considerably better. Excessive timbering was required, because it was necessary to keep the entire stope open. The preferred method for planer mining would be to retreat and allow the mined part of the stope to cave, keeping open only as much area as was required for working room. Retrievable steel props, such as those used in European long-wall coal mines and imported for use in the eastern coalfields, probably would facilitate this type of operation. A retreating caving method should relieve the pressure on the face and in the working area adjacent to it.

Future tests are planned in underground mines in the south-east Idaho–northern Utah part of the field. Since completion of the test operation at the Anderson mine the planer has been modified to mine the thicker beds found in the south-east Idaho–northern Utah area. During the next test attention will be given to co-ordinating the entire operation, including muck disposal and ground control. Developing a method for mechanized, systematized ground control with yielding, retrievable steel props will receive special attention.

Trade Paragraphs

Heyes and Co., Ltd., of Wigan, have received orders from the N.C.B. for their new type 40 shaft-signalling indicator. This can be supplied to meet individual requirements and provision can be made for mounting extra relays and indicators. Engine-house installations consist basically of three groups of equipment—the relay and battery group, the visual signal group, and the audible signal group.

Michigan (Great Britain), Ltd., of 3–5, Charles II Street, St. James's Square, London, S.W. 1, make available some particulars of a new back-hoe attachment (as illustrated) now available with three of their tractor shovels. The maker's notes state that simultaneous movements of boom and bucket can be made with ease. One lever hydraulically controls the boom action and one the bucket action. Individually-adjusted outrigger feet will level the machines on slopes up to 15°.

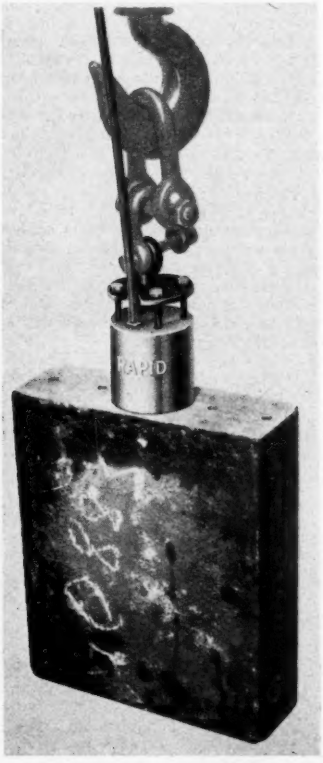
Griffin and George, Ltd., of Ealing Road, Alperton, Middx., announce that they have formed a new company to conduct research into and the development of new and improved scientific instruments and apparatus for laboratory use and process control. They state that a major part of the company's effort will be directed towards a review of modern analytical

Michigan Shovel with Back Hoe

techniques and the development of the instruments and apparatus for applying them in the laboratory and on the plant.

Goodyear Tyre and Rubber Co. (Great Britain), Ltd., of Wolverhampton, announce that one of the biggest single lengths of conveyor belting ever built by the company was recently completed. Constructed in 32-oz. cotton duck, this 42 in. by 8-ply Stacker belt, with a top cover of $\frac{1}{4}$ in. and a bottom cover of $\frac{3}{32}$ in., runs to a length of 1,350 ft. and weighs approximately 11 tons. A Leno breaker was included in the construction of the top cover to prevent gouging, cover stripping, and loading-impact cuts. The belt is to be used for carrying iron ore.

Rapid Magnetic Machines, Ltd., of Lombard Street, Birmingham, illustrate here an example of their steel handling magnet. This is suitable for lifting and transporting or for holding and can also be adapted for attaching to hoist hooks, manipulating arms, or other indexing devices. In cases where extra long or unusual shapes are concerned one, two, or more magnets attached to a suitable rig can be made. The inclusion of this Midget



magnet in the company's range means that this now covers magnets from 2 in. to 76 in. diameter, weighing from a few ounces to 6 tons.

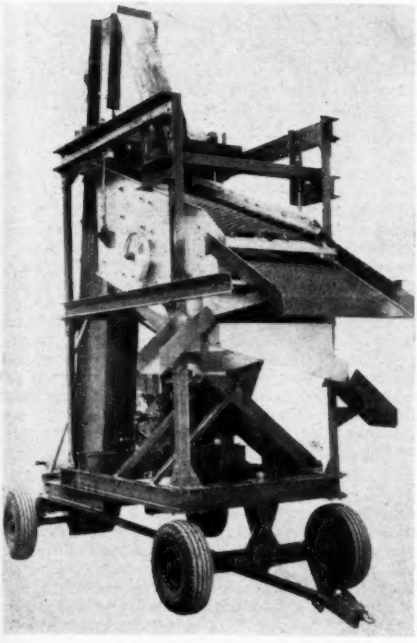
Consolidated Pneumatic Tool Co., Ltd., of 232, Dawes Road, London, S.W. 6, state that a new lightweight support leg for use in conjunction with their range of rock-drills has been introduced. This unit, which is alternative to the standard range of steel air-legs, has a weight of 32 lb. and is fabricated from Dural. Specifications include a stroke of 4 ft., a bore of $2\frac{1}{4}$ in., and an overall length when closed of 5 ft. 10 in. The length when fully extended is 10 ft. 1 in. It represents a weight saving of $26\frac{1}{2}$ lb. as compared with the equivalent steel version and will considerably increase the handling qualities of the air-leg range of drills.

ABEM Co. (AB Elektrick Malmletning), of Danderydsgatan 11, Stockholm, issue a number of new leaflets giving particulars of additions to their range of instruments and accessories of interest in geophysical exploration. These include a generator set for providing the current required in geo-electrical methods ; a transistor convertor designed to reduce weight and therefore suitable for airborne work ; laboratory oscillographs and galvanometers, and a direct-writing recorder also for use in airborne prospecting service. A separate leaflet gives general details of the Swedish two-plane electromagnetic ore-prospecting system. Other interesting publications are reprints of papers before the last meeting of the European Association of Exploration Geophysicists at the Hague.

Mavor and Coulson, Ltd., of Farme Cross, Rutherglen, Glasgow, have compiled a fully-illustrated 32-page catalogue describing their idlers for belt-conveyors, which includes full tables of sizes and weights, views of applications, sectional pictures, and an explanation of how the idlers are able to run so easily for so long. The types include idlers for belts from 14 in. to 60 in., cushion rollers of which 70% is rubber, steering idlers for reversible belts, idlers for picking belts, return idlers—plain, covered, disc for sticky material, and steering—also idler-boards and inverted troughing for carrying the idlers. A chart gives the width and speed of belts for conveying any of six weights of material at any required rate. Among examples of the company's belt-conveyor installations illustrated are those showing carrying of platinum ore, disposal of diamond tailings near Kimberley, and open-cast operation in Malaya.

Morgan Crucible Co., Ltd., of Battersea Church Road, London, S.W. 11, announce that recent increases in the demand for their sintered metal products have led to a move to larger premises. The sales office is now at Wandsworth Works, Point Pleasant, London, S.W. 18, and a new factory and laboratory has been established there for the production and development of Sinterlink. The need for these facilities has been dictated by the rapidly expanding employment of "Sinterlink" sinter-metal clutch-facing material for heavy-duty machinery in such fields as earth-moving equipment, industrial engines, cranes, tractors, and mechanical-handling equipment. The associated company, Morgan Refractories, Ltd., in a recent leaflet call attention to Tri-Mor Dense Guncrete. This is a new material which will withstand temperatures up to 1,300° C. and can be applied with a cement gun in furnace construction or repair.

Moxey, Ltd., of 13, Augustus Road, Birmingham, 15, call attention to their portable screening plant which may be of interest to small placer operators and has been designed for sand and gravel workings, etc. As may be seen from the illustration material may be delivered by hand, excavator, or grab into the feed hopper ; it is lifted by bucket elevator and fed on to the full width of the screen.



Oversize is rejected by chute, whilst graded materials may be loaded by further chutes to vehicles. This plant is powered by an air-cooled diesel engine and is capable of continuous operation over long periods. Maximum screening efficiency is given by the Moxey-Dillon, full-floating, circle-throw, vibrating screen, it is stated, which because of its design and suspension, transmits no vibration to supporting structure or chassis. These screens are described in a fully-illustrated booklet.

BTR Industries, Ltd., of Herga House, Vincent Square, London, S.W. 1, announced last month that they have recently completed a contract for the supply to a large ore field in the U.S.S.R. of nearly six miles of rubber-covered conveyor belting. This vast Soviet conveyor installation is believed to be unique in demanding belting of exceptional width designed to standards never before attained and in that it is the first application of 100% Terylene fabric in a major conveyor system. The special heavy fabric was woven to BTR design from 376,000 lb. of Terylene yarn. The belting was supplied in three widths: 1,400 mm. (55⅛ in.), 1,600 mm. (63 in.), and 2,000 mm. (78¾ in.) and shipped in 50 rolls each containing about 180 metres (590 ft.) of belt. It is made up of 8 to 14 plies of Terylene fabric with skim coats between plies—the widest belting with a 6 mm. thick top cover, including a nylon transcord breaker and a 2 mm. thick back cover. Terylene was chosen for the job because it is the fibre having the best combination of outstanding strength whether wet or dry, flexibility and resistance to impact, stretching, abrasion, and rot. The maximum working tension in the wide belting is 60,000 kg. (59 tons) and is capable of transmitting in excess of 1,000 h.p. The 14-ply by 78¾ in. belting, the makers state, is some of the widest and toughest ever made yet, as with the narrower constructions, it troughs readily under its own weight. The belts are being vulcanized endless on site with equipment designed and supplied as part of the contract.

Quasi-Arc, Ltd., of Bilston, Staffs, draw attention to the use of a combination of welded and bolted construction in the design of a dragline, as a result of which dismantling for ease of transport and re-erection at a new site is facilitated. The machine referred to is the Rapier W300, manufactured by **Ransomes and Rapier, Ltd.,** of Ipswich, and described in the MAGAZINE in May last. A second such machine has recently been completed. Twelve major welding runs, it is stated, totalling 150 ft., are necessary in assembling the main units of the dragline structure. Seven major welded assemblies form the main base and superstructure elements, the whole being of unit construction. To minimize site welding the main construction was, where possible, carried out at the Ipswich works. The main base was welded in three parts on manipulators in the workshop, using appropriate electrodes, particularly Radian and Ferron (New Type). While positional welding was avoided wherever possible, it was carried out when necessary with Vortic electrodes. Any tendency to distortion was avoided by bracing various sections prior to welding. Each assembly is complete with the machinery, drive, and other components ready for quick mechanical or electrical inter-connexion. Welding along prepared edges, to complete a rigid structure, is carried out when the main units have been bolted together and the welds are made along adjoining edges of main-plate members of the welded units in positions which allow down-hand working. Flame-cutting is used to dismantle the machine and is carried out along the welds. The spacing is designed so that other structural members are clear, necessitating only a minimum of making good by welding.

Johnson, Matthey and Co., Ltd., of 73–83, Hatton Garden, London, E.C. 1, announce that they have recently investigated the influence that different metallic structures and physical conditions have upon the performance of high-purity silver anodes in silver-plating baths. Several important conclusions were reached and as a result the company has developed a new type of silver anode. These Matthey C.A. anodes, because of special processing, have a structure consisting of small equi-axed grains and are particularly resistant to flaking or shedding in high-speed plating baths. Moreover the anodes show remarkable tolerance to variations in the composition of the electrolyte and in anode current density, it is stated. Another recent statement from the company refers to the production and marketing of Mallory 1000, a machinable high-density material composed of tungsten, nickel, and copper and made by a special powder metallurgy technique. Mallory 1000 has a uniform structure, high strength, and great density. As the material may be subjected to all normal machining and grinding processes it is ideally suitable for the manufacture of components where high mass coupled with high strength and small volume are important considerations. Components fabricated from it are finding increasing application as counterbalances for aircraft control surfaces, balances for flywheels, inertia members in such instruments as accelerometers, and as rotating inertia members, where strong precision-machined rotors are required in a

limited space. A further major application is in radiation shielding in which, by virtue of its physical structure and very high density, it effectively absorbs gamma rays and can also be used for the shielding of neutron-emitting fission by-products, provided that the intensity of bombardment is relatively low.

Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, devote the whole of the January issue of their *Gazette* to a fully-illustrated review of work and progress in 1958. In a foreword reference is made to the recent decision of Associated Electrical Industries, Ltd., to change to a divisional organization based on products and the first two divisions became operative on July 1 last. They incorporate the interests of Metropolitan-Vickers Electrical Co., Ltd., and the British Thomson-Houston Co., Ltd., in their respective fields and both have manufacturing, design, and commercial facilities at Trafford Park and Rugby. The A.E.I. Turbine-Generator Division is responsible for steam and gas turbines of all types, turbo-type generators and synchronous condensers, axial-flow compressors, condenser and heat-exchange plant of all kinds, and geared-turbine marine propulsion machinery and has its headquarters at Trafford Park. The A.E.I. Heavy Plant Division has headquarters at Rugby and covers large electrical machines for hydro-electric, mine winding, rolling mill, and general heavy industrial applications; centrifugal compressors, blowers, exhausters, and boosters; diesel-electric and turbo-electric marine propulsion units and ships' auxiliaries; gears and gearing and power rectifiers of all types. The activities of the Heavy Plant Division are dealt with in the notes which appear on p. 189, which are continued from the February issue.

In the course of the section dealing with mines in the *Gazette* reference is made to overseas business in the year under review. This included a contract from the **Mining Engineering Co., Ltd.,** of Worcester, for 21 40-h.p. squirrel-cage motors for conveyor drives for Steep Rock Iron Mines, Ltd., Ontario, and additional electrical equipment supplied to N'Changa Consolidated Copper Mines, consisting of six 1,000-h.p. motors (1,475 r.p.m., 3·3 kV) for driving main underground pumps.

G.E.C. Activities in 1958

The General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C. 2, have compiled their usual annual review and some extracts follow :—

Winding Engines.—Included in the winding engines commissioned for the N.C.B. during the past 12 months are two 2,100-h.p. a.c. winders for the downcast and upcast shafts at Lea Hall Colliery, in the West Midlands Division, and a 1,400-h.p. a.c. service winder for the Llanbradach mines, Glamorgan (for which an a.c. skip winder of the same rating is also being built). This is the first in Britain to use the company's simplified control scheme of compensated dynamic braking. In the new form of control the valve of the assister gear, which actuates the liquid resistor in the rotor circuit, is arranged for direct electrical operation, thereby dispensing with one hydraulic actuator. The control generator used in the earlier scheme has also been eliminated. This system of control lends itself readily to conversion at a later date from a simple compensated dynamic braking scheme to one embodying speed control.

The 4,480-h.p. twin-motor d.c. winder for Mount Isa Mines, Queensland, the largest ever to be installed at an Australian mine, has been successfully commissioned. The equipment embodies automatic push-button control from 12 levels and can deliver 180,000 tons of ore from mine to mill each 28-day period. It replaces an earlier G.E.C. winder which has given over 26 years' service but is now too small to meet the increased output of the mine.

For Silverwood Colliery, where a 3,700-h.p. geared d.c. winder was commissioned some 18 months ago, the N.C.B. has placed a further order for a 2,100-h.p. double-drum, single-clutch, a.c. winder for the West shaft. It will be used as a service winder operating from a maximum depth of 2,458 ft. Also for the N.C.B. are a 2,900-h.p. double-drum a.c. winder for Barnburgh Colliery No. 5 shaft and a 2,000-h.p. double-drum winder for Cortonwood Colliery No. 1 shaft.

G.E.C. Iron-Ore Blending Plant in Italy.

A contract placed by the Anglo American Corporation of South Africa covers all the electrical equipment for a multi-drum Blair-type winder with four ropes for installation at the President Brand mine, Orange Free State. The winder will raise a maximum of 230 tons of rock an hour from a depth of 5,600 ft. It will be driven by two 6·6 kV slipring motors with a combined output of 3,600 h.p. and the control scheme will incorporate compensated dynamic braking. The mechanical parts of the winder will be built in South Africa.

Switchgear.—The first Canadian order for type OAA 12 16-kV outdoor oil circuit breakers designed specifically for that market has been delivered. To comply with Canadian requirements, and also with a view to satisfying German and other Continental specifications, development work has been directed towards increasing the impulse-withstand voltage levels of 11-kV switchgear. It has been found possible to achieve peak impulse to withstand voltages of 75 kV on existing type KA switchgear by tapping certain busbar and current-transformer joints.

Fan Engineering.—Sixty-inch and 75-in. diameter Aerofoil fans by **Woods of Colchester, Ltd.,** have been introduced, giving air volumes up to 75,000 c.f.m. with standard impellers. A further development to extend the volume range is the introduction of Aerofoil fan impellers having only one-half or one-third of the normal number of wings. These fans are used to obtain the maximum air volume displacement at reduced pressure within the power limitations of the motors and thus enable air volumes up to 100,000 c.f.m. to be obtained. Guide-vane fans have been introduced to cater for applications requiring more pressure development than a single-stage fan is capable of giving, but not so much as a two-stage contra-rotating fan can develop. There are two types: Downstream guide-vane single-stage fans in two sizes, 24 in. and 30 in., with power outputs up to 50 h.p. and two-stage fans operating on a double-shaft extension motor with inter-stage guide vanes. In addition an attachable downstream guide-vane unit, designed primarily as an air straightener, is now offered for use with single-stage fans. In certain instances this unit will produce an increase in static pressure up to 15% without increasing horsepower.

Underground Listening Equipment.—A highly efficient electronic listening equipment has been developed to enable miners trapped underground to make their presence known to rescue parties. Of the various possible methods of communication the most attractive is an electro-acoustic one, because it does not require the trapped men to have any special equipment with them. The principle involved is that they shall strike the walls, roof, or floor of the space in which they are trapped with anything available—such as, a tool or a piece of rock—and that the sound travelling through the ground shall be picked up by rescue teams equipped with sensitive electronic detectors. The new equipment uses a geophone (a special form of transducer) spaced up to 100 yd. away from an amplifier incorporating modern low-noise valves and a special switched input circuit which enables the most favourable frequency in the band 25 c/s to 250 c/s to be selected. Clear hammering signals have been obtained underground over distances of more than a quarter of a mile, even when machinery was contributing a considerable amount of "earth noise."

BTH Review of Progress [1]

Mining Equipment (*Manchester*).—Orders have been received for winders of ratings from 300 h.p. to 5,220 h.p. The acceptance of mercury-arc rectifiers for mine-winder application has been further marked by the receipt of orders for six equipments with this type of drive, making a total of fourteen equipments now on order or in operation. Notable among new orders for rectifier winders are two equipments ordered for Dawdon Colliery in the Durham Division of the N.C.B. These are rated at 1,000 h.p. and 2,000 h.p. respectively and a direct-coupled overhung armature d.c. motor will be used in each case to drive a four-rope tower-mounted friction winder. An order has also been received for a 2,500-h.p. geared tower-mounted friction winder for Parkside Colliery which will be a duplicate of four other equipments previously ordered by the North Western Division of the N.C.B. Work is also in hand for an 850-h.p. geared four-rope friction winder for Houghton Main Colliery and for a 1,250-h.p. geared drum winder for Whitwell No. 1 Colliery. Another equipment ordered during the year is for a 1,200-h.p. geared drum winder for New Consolidated Gold Fields for an underground inclined shaft for Venterspost Gold Mining Co. It is believed that this will be the first rectifier-fed winder equipment in South Africa and the first in the world to be installed underground. A 1,000-h.p. Ward-Leonard winder has been ordered for the Hamilton shaft of Great Boulder Mines, Ltd., in Australia, while two winders have been ordered for Northern Rhodesia, one rated at 2,650 h.p. and the other at 4,300 h.p. (final duty).

A number of a.c. winder equipments have also been ordered both for home and overseas. For the N.C.B. these include a 2,000-h.p. drum winder with dynamic braking for Penrikyber Colliery and two winders rated at 1,100 h.p. and 1,500 h.p., also including dynamic braking, for Brynlliw Colliery. Two notable overseas orders are for a 4,200-h.p. twin-motor double-drum geared winder for Anglo American Corporation of South Africa and a 5,200-h.p. twin-motor four-rope friction winder for Mindola No. 2 shaft in Rhodesia. The latter will be a tower-mounted winder and the control system, employing rotor contactors and resistors, will enable the winder to be operated automatically when ore winding.

In addition to winders orders have also been received from the N.C.B. for a number a haulages ranging up to 400 h.p. and for man-riding carriages. A number of the former are of flameproof construction suitable for underground situations, while the latter employ patented track brakes and rope clamps enabling them to be used safely on inclines as steep as 1 in 3.

In the overseas field a number of winders have been brought into operation. Notable amongst these is a 3,000-h.p. Ward-Leonard Ilgner cage winder with oil-servo control at the North Broken Hill No. 3 shaft in Australia and the 4,300-h.p. a.c. geared four-rope friction winder at Stilfontein Gold Mining Co. in South Africa. The latter employs two motors controlled by rotor contactors

[1] Concluded from the February issue, p. 126.

and grid resistances and dynamic braking excitation is derived from a steel-tank mercury-arc rectifier. Additional equipment is soon to be commissioned to enable the winder to be operated automatically. In addition to the above erection has commenced in South Africa on the first of two 6,700-h.p. geared double-drum Ward-Leonard winders for New Consolidated Gold Fields at Saaiplaas shaft. This equipment is provided with the "Lamex" control scheme and automatic operation of the winder is included.

On all the closed-loop winders mentioned above it is necessary to provide camgear to retard the winder at the appropriate point in the cycle. For this purpose miniature type camgear has been produced which can be provided with either a mechanical long-range feature for deep shafts, or with a magnetically-operated clutch for multi-level winding or for friction winders. The clutch can be initiated by shaft switches of the magnetic-type which have also been developed. These and other features for safe and efficient winding have been provided whenever they are required.

Mercury Arc Rectifiers.—The most outstanding event in 1958 was the completion of the 194,000-kW pumpless steel-tank rectifier installation at Baie Comeau. This installation, supplied to Canadian British Aluminium Co., Ltd., for aluminium smelting, is the largest pumpless multi-anode rectifier station in operation and supplies one of the most modern and efficient aluminium smelter plants yet constructed. The first section of the plant was officially opened on June 14, 1958, by the Prime Minister of Quebec, although, in fact, the rectifier plant had commenced operation several months earlier. The second section commenced service on September 17.

An important new trend in British engineering practice has been the extensive use of rectifiers and inverters for supplying mine winders. This development was pioneered by M-V in 1957 and continued throughout 1958. Twelve rectifier equipments with a total of over 10,000 kW are being supplied for winder equipment. A special design of rectifier, with associated static control circuits to provide a wide range of voltage control and quick response, has been developed for such heavy-duty grid-control applications. For winder duty and similar drives it is most important to determine the best field of application for the various methods that enable a reversal of power flow to take place in the d.c. machine. Large installations are operating or under construction using armature reversal and field reversal respectively. Experience with these different schemes will enable an accurate assessment to be made of the best arrangements for various duties.

Semiconductor Rectifiers.—The unequalled facilities available in the new semiconductor factory resulted in important further progress in germanium rectifier cells during 1958. Germanium and silicon rectifier equipments installed or on order already exceed a total of 150,000 kW. Several of these are operating at d.c. voltages higher than those of any other manufacturer's equipments.

Among the germanium rectifiers for electrolytic duty, where their high efficiency and reliability are of particular significance, may be mentioned the commissioning of the 80,000-amp., 230-volt installation for the Associated Ethyl Co., Ltd., and a 13,000-amp., 150-volt equipment supplied for copper refining in Central Africa. Numerous other orders have been received including an order for two 11,250-amp., 678/562-volt equipments for the Electrolytic Zinc Co. of Australasia, Ltd.

RECENT PATENTS PUBLISHED

☛ A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

4,211 of 1955 (808,914). MARKISCHE STEINKOHLENGEWERKSCHAFT. Wet separation of mixtures of different specific gravities.

17,385 of 1955 (807,996). PREPARATION INDUSTRIELLE DES COMBUSTIBLES. Densimetric separation of solids.

23,957 of 1956 (808,637). DIAMOND ALKALI CO. Recovery of selenium.

26,086 of 1956 (808,230). SOC. GENERALE METALLURGIQUE DE HOBOKEN. Electrolytic separation of nickel from cobalt.

36,707 of 1957 (809,229). METALLGESELLSCHAFT A.-G. Sintering process and apparatus for producing hard pellets.

NEW BOOKS, PAMPHLETS, ETC.

☛ Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

Fine Particle Measurement : Size, Surface, and Pore Volume. By C. ORR, Jnr., and J. M. DALLAVALLE. Cloth, octavo, 353 pages, illustrated. Price 73s. 6d. New York and London : The Macmillan Company.

Systematic Mineralogy of Uranium and Thorium : United States Geological Survey Bulletin 1064. By C. FRONDEL. Paper covers, 400 pages, illustrated. Price $1·50. Washington : Superintendent of Documents.

Second Symposium on Coal Preparation. Cloth, octavo, 513 pages, illustrated. Price 20s. Sheffield : Coal Preparation Plant Association.

International Tin Council : 2nd Annual Report, 1957–58. Paper covers, 24 pages. Price 7s. 6d. London : International Tin Council.

Caribbean Geological Congress : Report of the First Meeting, held at Antigua, B.W.I., December, 1955. Paper covers, 70 pages, illustrated. Demerara : Argosy Co., Ltd.

Bechuanaland Protectorate : (1) Geological Survey Dept. Report, 1957 (2s. 6d.). (2) Records of the Geological Survey, 1956 (5s.). Lobatsi : Geological Survey Dept.

British Guiana : Geological Survey Dept. Report, 1957. Paper covers, 75 pages, illustrated. Georgetown, Demerara : Geological Survey Dept.

International Tin Research Council : Annual Report, 1958. Paper covers, 39 pages, illustrated. Greenford, Middx. : International Tin Research Council.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE. † Article digested in the MAGAZINE.

Economics

Legislation, Canada : *Survey, 1958.* Mineral Legislation, 1958. E. C. HODGSON, *Canad. Min. Res. Div. Bull.* MR 29.

Production, Africa : *Diamonds, Tanganyika.* The Williamson Diamond Mine. G. J. DU TOIT, *Mine, Quarry Engg.*, Mar., 1959.

***Production, Africa :** *Mineral, Tanganyika.* Tanganyika Mining Industry, 1958. THE MINING MAGAZINE, Mar., 1959.

Production, Canada : *Asbestos, Quebec.* Asbestos Production Underway at Black Lake. *Min. Engg.*, Jan., 1959.

Resources, United States : *Barite, Review.* Barite Resources of the United States. D. A. BROBST, *U.S. Geol. Surv. Bull.* 1072-B.

Utilization, Methane : *Equipment, United Kingdom.* Surface Equipment for Methane Drainage and Utilization in North Staffordshire. J. SUTTON, *Min. Elec. Mech. Eng.*, Feb., 1959.

Geology

Economic, Africa : *Copper, Rhodesia.* The Structure of the Roan Antelope Deposit. F. MENDELSOHN, *Bull. Instn. Min. Metall.*, Mar., 1959.

†Economic, Africa : *Diamonds, Transvaal.* The Diamond Occurrences near Swartruggens, Transvaal. G. P. FOURIE, *S. Afr. Geol. Surv. Bull.* 26.

Economic, Africa : *Salt, Bechuanaland.* A Reconnaissance Report on the Salt Domes of the Nata River Delta. O. J. VAN STRATEN, *Rec. Geol. Surv. Bech.*, 1956.

Economic, Caribbean : *Pyrite, Cuba.* Banded Pyrite Deposits of Minas Carlotta, Cuba. P. A. HILL, *Econ. Geol.*, Dec., 1958.

Economic, Exploration : *Symposium, Canada.* Symposium on Saturation Prospecting. *Canad. Min. Metall. Bull.*, Jan., 1959.

Economic, Mexico : *Sulphides, Chihuahua.* Structure of the Ore Deposits at Santa Barbara. J. B. SCOTT, *Econ. Geol.*, Dec., 1958.

Economic, United States : *Uranium, Utah.* Structural Relations at the Hideout No. 1 Uranium Mine, Deer Flat Area, San Juan County. T. L. FINNELL, W. B. GAZDIK, *Econ. Geol.*, Dec., 1958.

Mineralogy, Economic : *Uranium, Phosphates.* Geochemistry of Uranium in Apatite and Phosphorites. Z. S. ALTSCHULER and others, *U.S. Geol. Surv. Prof. Paper* 314-D.

Regional, Canada : *Survey, N.W.T.* Stratigraphy and Sedimentation of Middle Ordovician and Older Sediments in the Wrigley–Fort Norman Area, Mackenzie District. W. A. BELL, *Canad. Min. Metall. Bull.*, Jan., 1959.

Survey, Geobotany : *Study, United States.* Vegetation of Northwestern North America as an Aid in Interpretation of Geological Data. R. S. SIGAFOOS, *U.S. Geol. Surv. Bull.* 1061-E.

Survey, Geochemistry : *Copper, Rhodesia.* Geochemical Drainage Reconnaissance for Copper in Northern Rhodesia. J. S. WEBB, J. S. TOOMS, *Bull. Instn. Min. Metall.*, Jan., 1959.

Survey, Geochemistry : *Tests, Copper.* Rubeanic Acid Field Test : Copper in Soils and Sediments. H. V. WARREN, R. E. DELAVAULT, *Western Miner*, Jan., 1959.

Survey, Radioactive : *Resources, United States.* Reconnaissance for Radioactivity in the Metal-Mining Districts of the San Juan Mountains, Colorado. C. T. PIERSON and others, *U.S. Geol. Surv. Bull.* 1046-O.

Metallurgy

***Handling, Bulk :** *Sponge, Titanium.* Bulk Handling Titanium Sponge. A. E. WILLIAMS, THE MINING MAGAZINE, Mar., 1959.

Hydrometallurgy, Thorium : *Separation, Resin.* Studies on the Separation of the Rare Earths from Thorium in Sulphate Solutions, Using Cation Exchange Resins. D. C. LEWIS, J. C. INGLES, *Canad. Mines Branch Res. Report* R 31.

Hydrometallurgy, Uranium : *Consumption, Reagent.* Effect on Reagent Consumption of Recycling Solutions in the Weak Acid Leaching of a Uranium Ore. V. M. MCNAMARA, W. A. GOW, *Canad. Mines Branch Res. Report* R 28.

Hydrometallurgy, Uranium : *Plant, Wyoming.* Why Moving Bed Ion Exchange System Was Adopted. S. H. DAYTON, *Min. World* (San Francisco), Feb., 1959.

Hydrometallurgy, Uranium. *Solution, Monitoring.* The Application of Square Wave Polarography to the Monitoring of the Uranium Content of Uranium Plant Solutions. E. GOLDBLATT, *J. S. Afr. Inst. Min. Metall.*, Feb., 1959.

Refining, Lead : *Effect, Antimony.* Effect of Antimony on the Drossing Rate of Lead. J. E. A. GOODEN, *Bull. Instn. Min. Metall.*, Jan., 1959.

Machines, Materials

Beryllium, Extraction : *Properties, Uses.* Le Beryllium. M. P. VACHET, *Chim. et Industrie*, Jan., 1959.

Conveyors, Resonance : *Behaviour, Study.* Balancing Problems Encountered on a Resonance Vibrating Conveyor. H. G. DENKHAUS, *S. Afr. Mech. Eng.*, Jan., 1959.

Gears, Tube-Mill : *Design, Study.* A Review of Some Tube-Mill Gears on the Rand, with Special Reference to Corrected Gears for Ball- and Tube-Mills. W. T. L. WAYMAN, *S. Afr. Mech. Eng.*, Jan., 1959.

Screens, Heated : *Coal, South Wales.* Electric Heating of Vibrating Screens. *Coll. Engg.*, Mar., 1959.

***Selenium, History :** *Properties, Uses.* A Note on Selenium. M. SCHOFIELD, THE MINING MAGAZINE, Mar., 1959.

Steel, Bar : *Supports, Roof.* A Light-Weight Steel Roof Bar for Roadheads. E. M. LOXLEY, *Coll. Engg.*, Mar., 1959.

Winder, Mine : *Friction, South Africa.* Friction Winder for Stilfontein. *S. Afr. Min. Engg. J.*, Jan. 23, 1959.

Mining

Alluvial, Dredging : *Tin, Malaya.* From Alaska Gold to Malaya Tin. C. M. ROMANOWITZ, *Min. World* (San Francisco), Feb., 1959.

Exploration, Drilling : *Survey, Hole.* The Case of the Elusive Orebody. A. J. NICOL, *Min. Engg.*, Jan., 1959.

Exploration, Drilling : *Techniques, Deep-Hole.* Developments in Core-Drilling Techniques for Deep Minerals Exploration. J. K. HAYES, V. READ, *Min. Engg.*, Jan., 1959.

***Filling, Stope :** *Use, Tailings.* Stope Filling. Ore-Dressing Notes, THE MINING MAGAZINE, Mar., 1959.

General, Africa : *Diamonds, Tanganyika.* The Williamson Diamond Mine. G. J. DU TOIT, *Mine, Quarry Engg.*, Mar., 1959.

†General, Canada : *Progress, Review.* Recent Canadian Developments in Mining and Metallurgy. J. CONVEY, *Western Miner*, Jan., 1959.

General, United States : *Gilsonite, Utah.* Gilsonite Mining. JOHN GRINDROD, *Coll. Engg.*, Mar., 1959.

†General, United States : *Rock, Phosphate.* Design and Test Operation of a Pneumatic Vibrating-Blade Planer. A. L. SERVICE, T. E. HOWARD, *Rep. Inv. U.S. Bur. Min.* 5437.

General, United States : *Uranium, Colorado.* The Gunnison Mining Company. J. E. QUINN, *Deco Trefoil*, Jan.–Feb., 1959.

***Handling, Railway :** *Locos, Shunting.* Shunting in Tandem. C. F. CARTER, THE MINING MAGAZINE, Mar., 1959.

Hygiene, Silicosis : *Suppression, Dust.* German Research and Techniques in Airborne-Dust Measurement and Suppression in Coal Mines. J. R. HODKINSON, *Trans. Instn. Min. Eng.*, Mar., 1959.

Hygiene, Ventilation : *Cooling, Underground.* The Cooling of Underground Galleries. D. R. SCOTT, *Trans. Instn. Min. Eng.*, Mar., 1959.

Hygiene, Ventilation : *Gradients, Temperature.* Some Temperature Gradients Observed in Specially Selected Underground Airways. G. G. WILES, J. H. QUILLIAM, *J. S. Afr. Inst. Min. Metall.*, Feb., 1959.

Hygiene, Ventilation : *Gradients, Temperature.* Wet-Bulb Temperature Gradients in Horizontal Airways. G. G. WILES, *J. S. Afr. Inst. Min. Metall.*, Feb., 1959.

Open-Pit, Africa : *Copper, Rhodesia.* Bucket Wheel Stripping at Nchanga's Copper Pit. *Min. World* (San Francisco), Feb., 1959.

***Power, Air :** *Systems, Review.* Compressed Air Systems. L. WALTER, THE MINING MAGAZINE, Mar., 1959.

Power, Electric : *Systems, Protection.* Protection of Distribution Networks. J. W. RICHARDSON, *Min. Elec. Mech. Eng.*, Feb., 1959.

Subsidence, Surface : *Measures, Control.* Control of Mining Subsidence. J. W. MCTRUSTY, *Coll. Engg.*, Mar., 1959.

Support, Roof : *Bolting, Study.* An Outline of the Theory and Practice of Roof Bolting. *Ind. Min. J.*, Dec., 1958.

Tunnelling, United States : *Copper, Utah.* Utah Sets Records at Bingham Canyon. *Min. World* (San Francisco), Feb., 1959.

Ore-Dressing

Cleaning, Coal : *Plants, Australia.* "Package" Washeries in Australia. *Coll. Engg.*, Mar., 1959.

Crushing, Potash : *Practice, Germany.* Why Germans Crush Potash by Impact.—Part I. K. SCHMIDLAPP, *Min. World* (San Francisco), Feb., 1959.

Flocculant, Pulp : *Types, New.* Polyacrylamides for the Mining Industry. M. F. MCCARTY, R. S. OLSON, *Min. Engg.*, Jan., 1959.

General, United States : *Phosphate, Florida.* Cyanamid Floats Coarse Phosphate. A. E. ROBERTS, *Min. World* (San Francisco), Feb., 1959.

General, United States : *Uranium, Colorado.* The Gunnison Mining Company. J. E. QUINN, *Deco Trefoil*, Jan.–Feb., 1959.

Sorting, Ore : *Systems, Study.* Grading Lump Ore. E. and G. E. SANDSTROM, *Mine, Quarry Engg.*, Mar., 1959.

†Uranium, Autunite : *Beneficiation, United States.* Beneficiation of Autunitic Ores. W. C. AITKENHEAD, J. A. JAEKEL, *Min. Engg.*, Jan., 1959.

unting
GAZINE,

German
easure-
J. R.
, 1959.

ground.
SCOTT,

erature.
pecially
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